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ASARCO

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July 30, 1998

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ENVIRONMENTAL
PROTECTION AGENCY
JUL 31 1998
MONTANA OFFICE

Edward Thamke
State of Montana
Department of Environmental Quality
Enforcement Division
P.O. Box 200901
Helena, Montana 59620-0901

Dear Ms. Zazzali and Mr. Thamke:

Enclosed is the draft February 1998 Plant Water Investigation Report that has been prepared by Hydrometrics for the Asarco East Helena Plant. Consistent with our earlier discussions, the report has been prepared in draft format. Two copies of the reports are included in this submittal.

The draft report summarizes the groundwater and surface water investigations that have occurred following the February 3, 1998 plant water loss from the Asarco East Helena Plant's water handling system. The conclusions of the groundwater elevation monitoring and water quality testing are contained in Section 5 of the draft report. Section 6 contains recommendations for continued supplemental groundwater monitoring.

Since additional sampling is scheduled in August 1998, your prompt review and concurrence with the recommendations are required. After you have reviewed the draft report, please contact me so that we may discuss your comments.

Sincerely,

Jon Nickel

Jon Nickel

Enclosure (2)

ASARCO Incorporated, P.O. Box 1230, East Helena, MT 59635
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SDMS # 1060838

FEBRUARY 1998 PLANT WATER INVESTIGATION REPORT ASARCO EAST HELENA

- DRAFT -

Prepared for:

ASARCO Incorporated
P.O. Box 1230
East Helena, MT 59635

Prepared by:

Hydrometrics, Inc.
2727 Airport Road
Helena, MT 59601

July 1998

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FEBRUARY 1998 PLANT WATER INVESTIGATION REPORT ASARCO EAST HELENA

- DRAFT -

1. INTRODUCTION

On February 3, 1998, Asarco plant personnel became aware of an unusual decrease in water levels in the plant water holding tanks. The plant water holding tanks recharge the pressurized underground plant water system. Asarco management immediately began an in-house investigation by initiating an inspection of the surface areas directly above the underground plant water system to detect if plant water was leaking and visible at the surface. No evidence of water leakage was observed during this inspection. Since no visible evidence of plant water leakage was observed, Asarco plant personnel initiated a systematic shut down of segments of the system in hopes of identifying the source of potential water loss. By isolating the numerous sections of the plant water underground system, Asarco was successful in achieving stability in the tank water levels. However after 2 days, water levels in the million gallon storage tanks again showed an unusual decrease and Asarco initiated further action.

On February 12, 1998, the majority of the pressurized underground piping system was permanently shutdown and Asarco began operating a new aboveground pipeline. Only three sections of the underground low pressure supply lines were not included in the shutdown since these sections were replaced in 1990. These three pipeline segments are: a section from Thornock Tank to the million gallon storage tanks; a section from the acid plant sump to the million gallon storage tanks; and a section from the million gallon storage tanks to the pump house. These sections are identified on Exhibit 1.

With Environmental Protection Agency (EPA) and the State of Montana Department of Environmental Quality (MDEQ) concurrence, Asarco initiated a groundwater and surface water investigation. This draft report summarizes the results of the investigation.

1.1 SUMMARY OF EVENTS

Asarco provided EPA with a detailed account of the circumstances and events surrounding the leakage from Asarco's underground plant water system in a February 26, 1998 letter to Susan Zazalli. The following description of events includes a brief synopsis of the information provided in Asarco's February 26th letter and a description of activities associated with the subsequent investigation.

- February 3, 1998 - Asarco management first became aware of an abnormal decrease in water levels in the million gallon water storage tanks indicating a possible leak from the pressurized underground plant water system. The entire aboveground route of the underground piping system circuit was walked. The surface areas above each pipeline section were inspected for any visible sign of leakage. No visual evidence of surface water leakage was observed. Consequently, Asarco began systematically isolating sections of the pipeline in an attempt to identify the potential source of water loss.

- February 4 - 5, 1998 - Second, third and fourth sections of the plant water system were isolated. Water level in the million gallon storage tanks, the measure of plant water losses, stabilized after the fourth section was isolated. Asarco believed the suspected leak(s) had been isolated.

- February 7, 1998 - The water level in the million gallon storage tanks again began another seemingly abnormal decrease.

- February 9, 1998 - A fifth, sixth and seventh section of the plant water system were isolated leaving only a small section of underground piping near the sinter plant active.

- February 9, 1998 - Non-essential portions of the underground plant water pressurized pipeline were permanently shutdown. Construction of an aboveground pressurized pipe to convey water to essential plant operations was initiated. A precautionary notification was provided to the National Response Center (NRC) although it had not been established whether a reportable quantity of any hazardous substance had been released into the environment.

- February 12, 1998 - Construction of the aboveground pressurized piping system was completed. The pressurized, underground plant piping system was permanently shutdown except for three low pressure supply lines. These lines transfer plant water either to or from the million gallon water storage tanks. These underground lines include routes from 1) Thornock Tank to the million gallon water storage tanks, 2) the acid plant drain sump to the million gallon water storage tanks, and 3) the million gallon water storage tanks to the pump house.

- February 13, 1998 - Asarco management met with representatives from the EPA and MDEQ to discuss the events and to agree upon a monitoring approach to investigate the potential impact of the plant water leak. As a result of the discussion, daily water level measurements were immediately initiated at 28 monitoring wells in order to determine the potential impact of the underground leak(s).

- February 13 - 18, 1998 - Water level measurements were collected at each of the 28 monitoring wells on a daily basis.

- February 16, 1998 -A small area of ground level subsidence was discovered near the sample mill.

- February 19 - 20, 1998 - Water quality samples were collected at ten monitoring wells, two surface water sites, and the plant water system.

- March 3, 1998 - Results of first water quality sampling round (February 19-20) were discussed in a meeting with EPA and MDEQ. Sample locations were reduced to include eight key monitoring wells that were in or downgradient of the area showing apparent effects from the plant water system losses. The parameter list was modified to include key indicator parameters.

- March 18 - 19, 1998 - A second water sampling event was conducted for the eight key monitoring wells.

- April 22 - 23, 1998 - A third water sampling event was conducted for the eight key monitoring wells.

- May 6 - 12, 1998 - A fourth sampling event was conducted for the eight key monitoring wells. Monitoring was conducted in conjunction with semi-annual Post Remedial Investigation/Feasibility Study (RI/FS) Monitoring as specified in a letter from Hydrometrics to EPA dated March 10, 1998.

2. SCOPE OF PLANT WATER INVESTIGATION

After the February 13, 1998 meeting between Asarco, EPA and MDEQ, Asarco initiated an evaluation of the effects of the suspected plant water leak on the groundwater system. The scope of the evaluation included the collection of water levels and development of a water quality sampling program. A map of the underground plant water piping system was reviewed to locate existing monitoring wells that are near the pipe route for evaluation monitoring. A total of 28 wells were chosen for monitoring water level only. The monitoring well list included both wells within the plant site area and downgradient wells within the City of East Helena. Exhibit 1 shows the plant layout, location of monitoring sites, and location of the underground plant water piping system.

Based on initial results of the water level measurements, and as stated in the February 18, 1998 letter from Hydrometrics to the MDEQ, ten wells, two surface water sites and the plant water system were selected for water quality sampling in order to assess the groundwater quality near the suspected plant water leak area. Initial sampling was conducted on February 19 and 20, 1998. After this first round of sampling, and as agreed upon with the EPA, the sampling program was modified to include only eight of the original ten wells (letter from Susan Zazalli to Jon Nickel dated March 10, 1998). In addition, the surface water locations (PPC-5 and PPC-7) were no longer monitored after the February 19 and 20, 1998 sampling round.

3. METHODOLOGY

A list of the 28 monitoring wells used for water level measurement are shown in Table 3-1. Exhibit 1 shows the location of the water level monitoring sites. Water level monitoring was initiated on February 13, 1998 and was conducted on a daily basis through February 18, 1998. Water level measurements were collected with a Solinst water level instrument at approximately the same time each day. Water level monitoring results are shown in Table 3-1.

The frequency of water level measurements was decreased from daily to monthly after February 18, 1998 and subsequent water level measurements were obtained at the same time water quality sampling was conducted; February 19 and 20, March 18 and 19, April 22 and 23 and May 6-12, 1998.

Groundwater water quality samples were collected from the locations listed in Table 3-2. Prickly Pear Creek stations PPC-5 and PPC-7 were monitored during February only and two samples of water from the plant water circuit were also collected for the investigation. The first plant water sample was collected on February 20, 1998. The second sample was collected on June 3, 1998.

Water quality samples were collected following procedures established for Post RI/FS Monitoring. Table 3-3 lists the analytical parameters, methods and detection limits for the investigation. Groundwater and plant water samples were analyzed for major anions and cations and dissolved metals only. Surface water was analyzed for major anions and cations and both total and dissolved metals. Arsenic speciation was conducted on the second plant water sample at the request of EPA.

Quality control samples were collected by Asarco during each of sampling rounds, which included collection of duplicates, field blanks or standards at frequencies specified in the Post-RI/FS Monitoring Plan. The MDEQ also collected field splits at selected sites (DH-9

TABLE 3-1. WATER LEVEL MEASUREMENTS - ASARCO EAST HELENA

(Feet - MSL)

Monitoring Well	May-97	Nov-97	2/13/98	2/14/98	2/15/98	2/16/98	2/17/98	2/18/98	3/18/98	4/22/98	5/7/98
APSD-13	3908.53	3909.89	3908.64	3908.66	3908.64	3908.66	3908.64	3908.64	3908.80	3909.57	3909.01
DH-5	3904.92	3904.73	3904.84	3904.84	3904.85	3904.85	3904.85	3904.85	3904.97	3904.96	3904.95
DH-6	3872.10	3874.87	3874.73	3874.74	3874.79	3874.79	3874.75	3874.71	3873.08	3872.14	3872.25
DH-8	3873.87	3879.92	3878.75	3878.80	3878.77	3878.74	3878.70	3878.62	3876.45	3874.74	3874.39
DH-9	3880.92	3884.87	3887.92	3887.55	3886.98	3886.40	3885.91	3885.58	3881.29	3882.09	3882.18
DH-10A	3876.99	3877.87	3878.07	3878.14	3878.09	3878.08	3878.05	3877.97	3876.87	3876.57	3877.17
DH-12	3877.52	3884.55	3884.05	3884.14	3883.94	3883.82	3883.69	3883.54	3880.56	3879.12	3878.70
DH-13	3878.08	3884.18	3883.82	3883.87	3883.68	3883.58	3883.46	3883.29	3880.36	3878.93	3878.63
DH-15	NA	NA	3875.31	3875.38	3875.34	3875.34	3875.29	3875.25	AB	3872.75	NA
DH-16	3872.05	3875.35	3874.77	3874.84	3874.72	3874.73	3874.67	3874.60	3873.76	3872.72	3872.47
DH-17	dry	3876.91	3876.38	3876.46	3876.38	3876.38	3876.32	3876.24	3874.06	dry	dry
DH-18	3879.10	3884.01	3882.30	3882.35	3882.27	3882.19	3882.13	3882.05	3880.71	3879.86	3879.53
DH-19	3901.32	3905.80	3902.89	3902.94	3902.87	3902.84	3902.82	3902.80	3902.55	3902.54	3902.60
DH-21	3886.18	3891.45	3892.07	3891.93	3891.47	3891.15	3890.78	3890.42	3887.30	3886.51	3886.40
DH-22	3896.81	3903.50	3898.56	3898.47	3898.47	3898.42	3898.37	3898.34	3897.70	3897.40	3897.52
DH-23	3900.75	3901.37	3901.69	3901.52	3901.40	3901.41	3901.22	3901.17	3900.67	3900.72	3900.72
DH-24	3868.20	3872.53	3871.38	3871.47	3871.37	3871.39	3871.36	3871.34	3868.50	3868.57	3868.36
DH-27	3895.14	3900.16	3897.40	3897.38	3897.15	3897.05	3896.96	3896.84	3895.75	3895.47	3895.40
DH-28	3886.06	3892.26	3891.90	3891.36	3891.05	3890.94	3890.75	3890.55	3888.37	3887.31	3887.23
EH-50	3859.15	3864.00	3861.07	3861.10	3861.01	3861.02	3860.97	3860.92	3859.99	3859.06	3858.83
EH-52	3869.80	3870.10	3869.50	3869.51	3869.52	3869.51	3869.52	3869.53	3869.37	3869.34	3869.70
EH-53	3842.99	3850.31	3844.79	3844.75	3844.72	3844.72	3844.42	3844.32	3842.16	3840.60	3840.31
EH-54	3857.80	3858.68	3857.30	3857.26	3857.17	3857.11	3857.06	3856.94	3856.02	3855.41	3856.20
EH-60	3863.44	3867.34	3865.47	3865.55	3865.43	3865.45	3865.42	3865.37	3864.45	3863.52	3863.31
EH-61	3862.87	3866.89	3864.92	3865.01	3864.90	3864.89	3864.88	3864.82	3863.87	3862.92	3862.72
EH-62	3846.10	3850.66	3846.94	3846.88	3846.71	3846.65	3846.55	3846.43	3844.33	3843.07	3843.44
EH-100	NA	NA	3860.91	3860.97	3860.86	3860.86	3860.83	3860.78	3859.85	3858.88	NA
EH-102	3867.99	3869.07	3868.13	3868.12	3868.11	3868.09	3868.08	3868.07	3867.66	3867.42	3867.79

NA - Well not included for monitoring under post RI/FS requirements.
AB - Access blocked.

TABLE 3-2. MONITORING SITES USED TO COLLECT WATER QUALITY SAMPLES

Monitoring Well	Feb-98	Mar-98	Apr-98	May-98
DH-6	2/19/98	3/18/98	4/22/98	5/6/98
DH-9	2/20/98	3/18/98	4/22/98	5/7/98
DH-10A	2/19/98	3/18/98	4/22/98	5/7/98
DH-12	2/20/98	3/18/98	4/22/98	5/7/98
DH-16	2/20/98	3/18/98	4/22/98	5/11/98
DH-21	2/20/98	3/18/98	4/22/98	5/12/98
DH-23	2/20/98	3/18/98	4/22/98	5/7/98
DH-24	2/20/98	3/18/98	4/22/98	5/11/98
DH-27	2/20/98	*	*	*
DH-28	2/20/98	*	*	5/11/98
PPC-5	2/19/98	*	*	*
PPC-7	2/19/98	*	*	*
Plant Water	2/20/98	*	*	6/3/98

* Location removed from monitoring requirements.

TABLE 3-3. PARAMETERS, ANALYTICAL METHODS, AND DETECTION LIMITS FOR SAMPLING INVESTIGATION OF PLANT WATER LEAKAGE

Parameter	Method	Detection Limit (mg/L)
pH	field + lab analyzed	--
Specific Conductivity	field + lab analyzed	--
Temperature	field analyzed	--
Dissolved Oxygen	field analyzed	--
Chloride	300.0	5
Sulfate	9036	5
TDS	160.1	10
METALS*		
Arsenic (As)	6020 ICP/MS	0.003
Barium (Ba)	6020 ICP/MS	0.005
Cadmium (Cd)	6020 ICP/MS	0.0001
Copper (Cu)	6020 ICP/MS	0.001
Chromium (Cr)	6020 ICP/MS	0.001
Lead (Pb)	6020 ICP/MS	0.003
Selenium (Se)	6020 ICP/MS	0.001
Silver (Ag)	6020 ICP/MS	0.003
Zinc (Zn)	6020 ICP/MS	0.01

* *Surface water samples analyzed for total and dissolved metals. Groundwater and plant water samples were analyzed for dissolved metals only.*

and PPC-7) during the first sampling round. After confirming the results of the first round, MDEQ discontinued collection of splits.

Prior to collecting groundwater samples, a minimum of three well bore volumes were purged from the well using a bladder pump system. Dissolved metals samples were filtered using a peristaltic pump and a disposable 0.45 micron filter. The sample collection equipment was decontaminated between samples by purging 2.5 gallons of deionized water through the pump and tubing.

Grab samples were collected at surface water monitoring sites (PPC-5 and PPC-7) by wading into the stream and filling sample bottles directly from the stream.

Samples for metals analysis were preserved with nitric acid. Dissolved metals samples were filtered with a 0.45 micron filter prior to preservation. All samples were packed on ice and shipped under chain-of-custody protocol to Asarco Technical Services Laboratory in Salt Lake City, Utah for analysis.

4. RESULTS

4.1 WATER LEVEL MEASUREMENTS

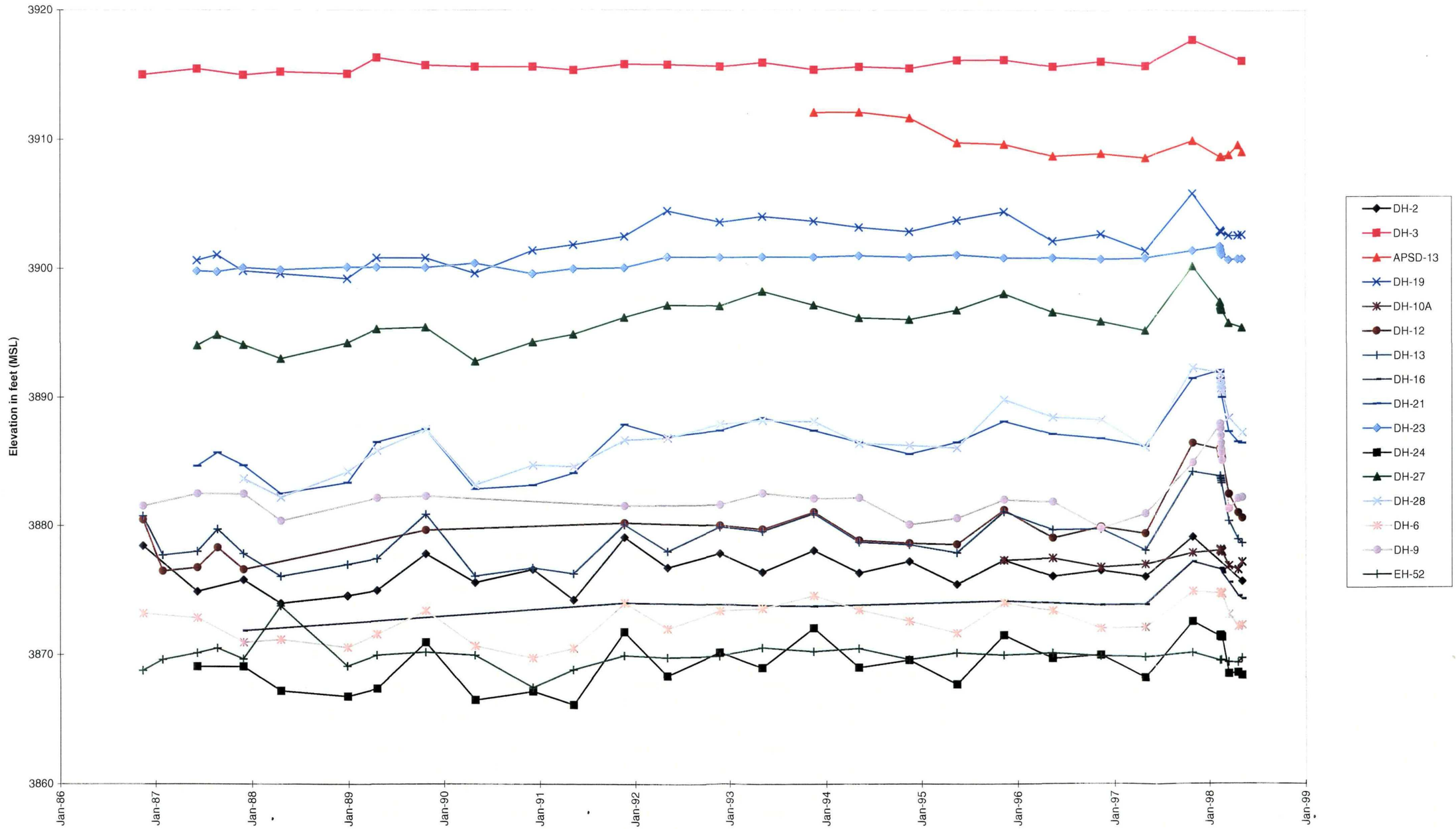
As stated above, the majority of the pressurized underground water system was permanently shutdown on February 12, 1998. Water level measurements were collected at area monitoring wells after the shutdown to help determine the effect of the plant water leakage on the water table.

Historical water level trends from plant site area monitoring wells and recent monitoring results are shown in Figure 4-1. The fall 1997 water levels in this graph show a pronounced increase reflecting the high spring runoff conditions in 1997 and continued precipitation events throughout the following summer months. High water levels in the fall of 1997 in both plant site monitoring wells and in monitoring wells upgradient of the plant site (DH-2 & DH-3) are attributed to high runoff and precipitation related recharge.

Between November 1997 and February 1998 the majority of the monitoring wells show a decline in water levels consistent with long-term seasonal trends. However, February 1998 water levels at DH-21, DH-23 and DH-9 show an increase which is counter to the general water level trends. This area of increase is in the vicinity of the underground pipeline and is likely an indication of the region where plant water leakage has occurred.

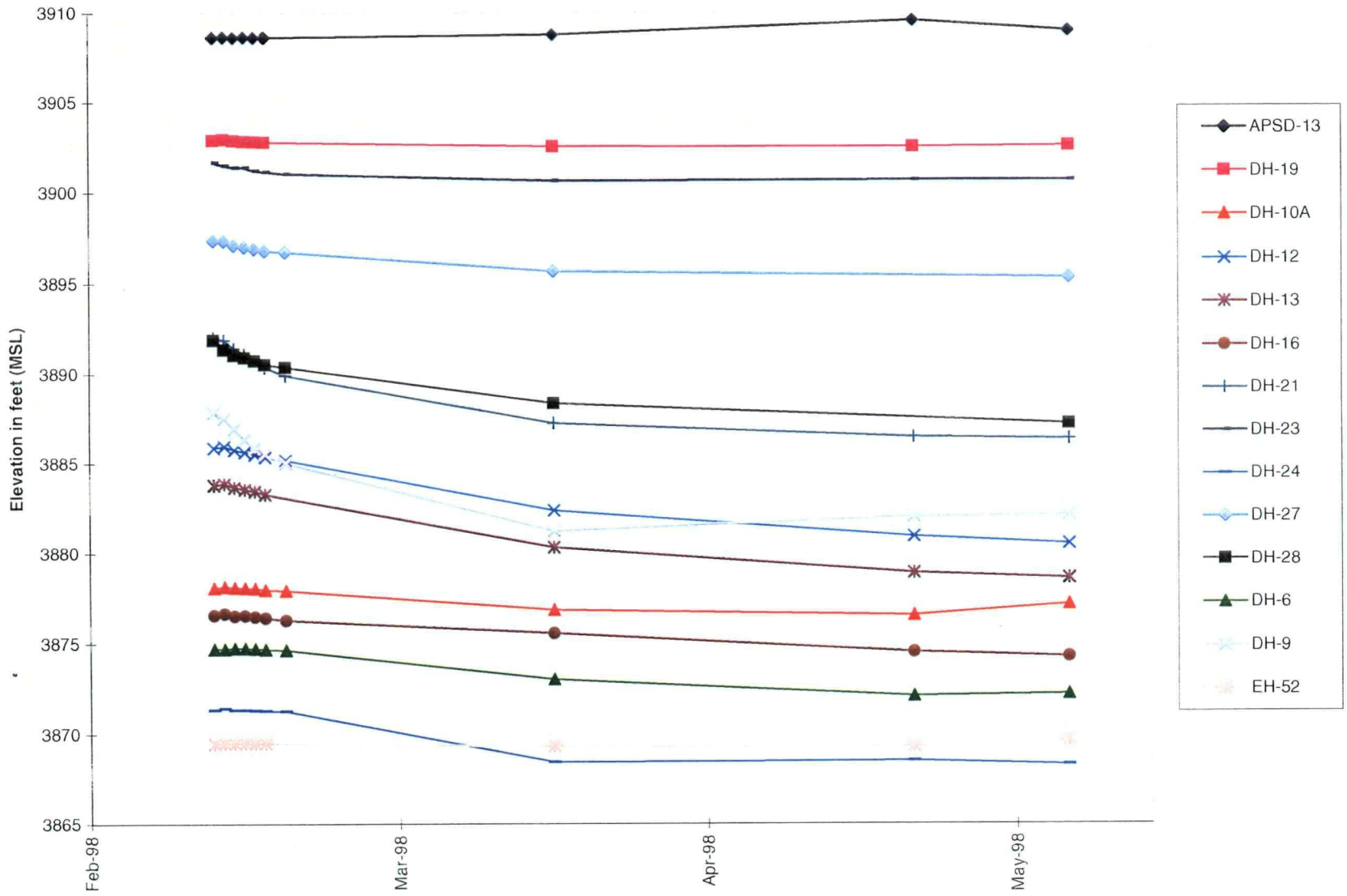
Water level results since shutdown of the underground pipeline in February 1998 are shown in Figure 4-2. Water level trends show a general decline during this period with the largest changes at DH-9, DH-21 and DH-28. Water levels in well DH-9 decreased 2.34 feet over the six day period from February 13 through February 18, while DH-21 and DH-28 decreased 1.65 feet and 1.35 feet, respectively. DH-12 and DH-13 decreased 0.51 feet and 0.53 feet, respectively over this same period.

Figure 4-1. Water Elevation at Selected Asarco East Helena Monitoring Wells
Period of Record



K:\data\project\0867\watlev1.xls

Figure 4-2. Water Elevation at Selected Asarco East Helena Monitoring Wells - Spring 1998



K:\data\project\0867\watlev1.xls

TABLE 4-1. SUMMARY STATISTICS FOR WATER QUALITY AT ASARCO EAST HELENA WELLS

SITE CODE	SAMPLE DATE	DISSOLVED (mg/L) TDS	SULFATE	CHLORIDE	ARSENIC	CADMIUM	COPPER	LEAD	ZINC
DH-10A	5/9/96	1289	790	23	1.12	0.005	0.0084	0.0066	0.02
	11/11/96	1736	1079	29	1.41	0.0015	0.009	0.005	0.015
	5/6/97	517	199	7	1.34	0.001	0.007	0.005	0.02
	11/6/97	2362	1258	75	1.72	0.001	0.009	0.005	0.02
	MIN	517	199	7	1.12	0.001	0.007	0.005	0.015
	MAX	2362	1258	75	1.72	0.005	0.009	0.0066	0.02
	MEAN	1476	832	34	1.39	0.0021	0.0084	0.0054	0.019
	STD DEV	776	464	29	0.25	0.0019	0.0009	0.0008	0.002
	MEAN+2SD	3028	1759	92	1.89	0.0060	0.0102	0.0070	0.024
	2/19/98	**2374**	**1337**	**136**	**1.20**	**0.0027**	**0.01**	**0.003**	**0.029**
	3/18/98	**2484**	**1356**	**146**	**1.2**	**0.0008**	**0.01**	**<0.003**	**0.017**
	4/22/98	**706**	**327**	**25**	**3.8**	**0.0003**	**0.004**	**<0.003**	**0.011**
	5/7/98	**453**	**148**	**14**	**3.30**	**0.0004**	**0.006**	**0.003**	**0.013**
	1998 Mean	**1504**	**792**	**80**	**2**	**0.0011**	**0.008**	**0.003**	**0.018**
DH-12	5/14/96	599	286	23	10.13	0.011	0.004	0.005	0.653
	11/12/96	605	269	17	7.9	0.0013	0.011	0.005	0.434
	5/7/97	511	217	19	8.077	0.005	0.004	0.005	0.445
	11/5/97	2599	1341	90	3.771	0.006	0.009	0.006	0.315
	MIN	511	217	17	3.77	0.0013	0.004	0.005	0.315
	MAX	2599	1341	90	10.13	0.011	0.011	0.006	0.653
	MEAN	1079	528	37	7.47	0.0058	0.0070	0.0053	0.462
	STD DEV	1015	543	35	2.67	0.0040	0.0036	0.0005	0.140
	MEAN+2SD	3108	1614	108	12.80	0.0138	0.0141	0.0063	0.743
	2/20/98	**3466**	**1911**	**170**	**24**	**0.0013**	**0.007**	**0.003**	**0.65**
	3/18/98	**1312**	**644**	**48**	**17**	**0.060**	**0.014**	**0.044**	**0.38**
	4/22/98	**697**	**280**	**29**	**12**	**0.054**	**0.016**	**0.042**	**0.28**
	5/7/98	**551**	**197**	**17**	**12**	**0.041**	**0.008**	**0.041**	**0.26**
	1998 Mean	**1507**	**758**	**66**	**16**	**0.0391**	**0.011**	**0.033**	**0.39**
DH-16/17	5/14/96	1974	903	147	58.77	0.005	0.004	0.005	0.144
	11/12/96	862	439	42	58.35	0.001	0.021	0.005	1.11
	5/7/97	592	261	24	52.79	0.001	0.004	0.005	0.696
	11/7/97	1032	532	45	32.9	0.001	0.004	0.005	2.826
	MIN	592	261	24	32.90	0.001	0.004	0.005	0.144
	MAX	1974	903	147	58.77	0.005	0.021	0.005	2.826
	MEAN	1115	534	65	50.70	0.0020	0.0083	0.0050	1.194
	STD DEV	601	271	56	12.18	0.0020	0.0085	0.0000	1.158
	MEAN+2SD	2316	1075	176	75.06	0.0060	0.0253	0.0050	3.509
	2/20/98	**1369**	**765**	**73**	**35**	**0.0011**	**0.003**	**0.003**	**4.1**
	3/18/98	**1744**	**1012**	**116**	**13**	**0.0006**	**0.004**	**0.003**	**3.7**
	4/22/98	**1560**	**968**	**79**	**31**	**0.0005**	**0.002**	**<0.003**	**4.7**
	5/11/98	**1384**	**747**	**55**	**36**	**<0.001**	**0.002**	**<0.003**	**4.1**
	1998 Mean	**1514**	**873**	**81**	**29**	**0.0008**	**0.0028**	**0.0030**	**4.15**
DH-21	5/14/96	7646	2602	371	354.3	0.005	0.014	0.011	0.046
	11/12/96	9050	3519	377	361.4	0.004	0.062	0.016	0.118
	5/8/97	7036	2244	220	333	0.007	0.054	0.016	0.02
	11/10/97	11747	3291	408	647	0.01	0.036	0.05	0.02
	MIN	7036	2244	220	333.00	0.004	0.014	0.011	0.02
	MAX	11747	3519	408	647.00	0.01	0.062	0.05	0.118
	MEAN	8870	2914	344	423.93	0.0065	0.0415	0.0233	0.051
	STD DEV	2095	593	84	149.21	0.0026	0.0213	0.0180	0.046
	MEAN+2SD	13060	4100	512	722.34	0.0118	0.0841	0.0592	0.144
	2/20/98	**6290**	**2278**	**423**	**300**	**0.022**	**0.062**	**0.014**	**0.039**
	3/18/98	**9213**	**3155**	**422**	**586**	**0.003**	**0.027**	**0.008**	**<0.01**
	4/22/98	**8712**	**3150**	**403**	**552**	**0.005**	**0.044**	**0.016**	**0.010**
	5/12/98	**7896**	**2317**	**369**	**441**	**0.003**	**0.052**	**0.013**	**0.01**
	1998 Mean	**8028**	**2725**	**404**	**470**	**0.008**	**0.046**	**0.013**	**0.017**

0.022 box around value indicates result is over the 95% confidence value

TABLE 4-1. SUMMARY STATISTICS FOR WATER QUALITY AT ASARCO EAST HELENA WELLS

SITE CODE	SAMPLE DATE	DISSOLVED (mg/L) TDS	SULFATE	CHLORIDE	ARSENIC	CADMIUM	COPPER	LEAD	ZINC
DH-23	5/10/96	930	399	77	2.542	0.249	0.026	0.019	1.32
	11/11/96	1098	472	90	2.35	0.308	0.059	0.031	1.39
	5/7/97	1158	513	108	2.534	0.216	0.042	0.038	1.179
	11/10/97	2297	1152	281	1.175	0.45	0.027	0.061	2.359
	MIN	930	399	77	1.18	0.216	0.026	0.019	1.2
	MAX	2297	1152	281	2.54	0.45	0.059	0.061	2.4
	MEAN	1371	634	139	2.15	0.3058	0.0385	0.0373	1.6
	STD DEV	625	349	96	0.66	0.1034	0.0155	0.0177	0.5
	MEAN+2SD	2621	1331	330	3.46	0.5126	0.0695	0.0726	2.6
	2/20/98	**2440**	**1308**	**284**	**1.3**	**1.7**	**0.056**	**0.044**	**5.0**
	3/18/98	**2195**	**1122**	**321**	**1.3**	**1.2**	**0.052**	**0.048**	**4.1**
	4/22/98	**1769**	**987**	**219**	**1.2**	**0.47**	**0.031**	**0.041**	**1.7**
	5/7/98	**1503**	**648**	**192**	**1.5**	**0.47**	**0.033**	**0.037**	**1.4**
	1998 Mean	**1977**	**1016**	**254**	**1.3**	**0.96**	**0.043**	**0.043**	**3.1**
DH-24	5/14/96	1649	928	144	38.47	0.276	0.0088	0.0073	11.18
	11/12/96	1431	823	102	33.68	0.212	0.029	0.005	10.4
	5/7/97	1427	616	57	38.36	0.162	0.006	0.005	8.293
	11/7/97	1216	688	63	25.79	0.131	0.014	0.005	6.741
	MIN	1216	616	57	25.79	0.131	0.006	0.005	6.7
	MAX	1649	928	144	38.47	0.276	0.029	0.0073	11.2
	MEAN	1431	764	92	34.08	0.1953	0.0145	0.0056	9.2
	STD DEV	177	139	40	5.96	0.0633	0.0103	0.0012	2.0
	MEAN+2SD	1784	1042	172	45.99	0.3219	0.0350	0.0079	13.2
	2/20/98	**1352**	**765**	**57**	**24**	**0.21**	**0.009**	**0.003**	**8.3**
	3/18/98	**1289**	**729**	**59**	**24**	**0.19**	**0.01**	**0.007**	**8.6**
	4/22/98	**1172**	**728**	**48**	**22**	**0.22**	**0.005**	**<0.003**	**8.2**
	5/11/98	**1115**	**668**	**42**	**24**	**0.22**	**0.006**	**0.004**	**8.3**
	1998 Mean	**1232**	**723**	**52**	**24**	**0.21**	**0.008**	**0.004**	**8.4**
DH-27	5/10/96	2345	1255	280	26.87	0.005	0.004	0.005	1.94
	11/11/96	1934	1219	102	31.39	0.001	0.045	0.005	1.57
	5/8/97	3453	1680	438	24.22	0.001	0.006	0.005	4.72
	11/11/97	2051	1301	108	19.33	0.001	0.004	0.005	2.149
	MIN	1934	1219	102	19.33	0.001	0.004	0.005	1.6
	MAX	3453	1680	438	31.39	0.005	0.045	0.005	4.7
	MEAN	2446	1364	232	25.45	0.0020	0.0148	0.0050	2.6
	STD DEV	693	213	160	5.04	0.0020	0.0202	0.0000	1.4
	MEAN+2SD	3833	1791	552	35.54	0.0060	0.0551	0.0050	5.5
	2/20/98	**1919**	**1156**	**92**	**20**	**0.001**	**0.005**	**0.003**	**2.1**
	5/11/98	**1376**	**745**	**104**	**19.85**	**<0.001**	**<0.004**	**<0.005**	**0.49**
	1998 Mean	**1648**	**951**	**98**	**20**	**0.001**	**0.005**	**0.004**	**1.29**
DH-28	5/10/96	3520	1491	270	95.57	0.005	0.0084	0.0065	0.047
	11/11/96	3787	1718	225	81.96	0.0036	0.037	0.005	0.103
	5/8/97	4133	1544	143	127.5	0.006	0.027	0.005	0.04
	11/11/97	3393	1573	170	74.76	0.003	0.009	0.005	0.023
	MIN	3393	1491	143	74.76	0.003	0.0084	0.005	0.0
	MAX	4133	1718	270	127.50	0.006	0.037	0.0065	0.1
	MEAN	3708	1582	202	94.95	0.0044	0.0204	0.0054	0.1
	STD DEV	327	97	57	23.35	0.0014	0.0141	0.0007	0.0
	MEAN+2SD	4363	1776	315	141.66	0.0071	0.0485	0.0069	0.1
	2/20/98	**4885**	**1875**	**188**	**222**	**0.0079**	**0.005**	**0.003**	**0.067**
	5/11/98	**2864**	**1409**	**145**	**122**	**0.002**	**0.004**	**<0.003**	**0.014**
	1998 Mean	**4037**	**1687**	**216**	**162**	**0.006**	**0.019**	**0.004**	**0.068**

0.022 box around value indicates result is over the 95% confidence value

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TABLE 4-1. SUMMARY STATISTICS FOR WATER QUALITY AT ASARCO EAST HELENA WELLS

SITE CODE	SAMPLE DATE	DISSOLVED (mg/L) TDS	SULFATE	CHLORIDE	ARSENIC	CADMIUM	COPPER	LEAD	ZINC
DH-6	5/9/96	1695	970	30	1.886	0.005	0.0064	0.005	0.02
	11/11/96	2548	1805	46	1.9	0.001	0.012	0.005	0.015
	5/6/97	1961	970	54	2.068	0.002	0.05	0.005	0.022
	11/6/97	1930	1098	81	2.281	0.001	0.009	0.005	0.02
	MIN	1695	970	30	1.89	0.001	0.0064	0.005	0.015
	MAX	2548	1805	81	2.28	0.005	0.05	0.005	0.022
	MEAN	2034	1211	53	2.03	0.0023	0.0194	0.0050	0.019
	STD DEV	363	401	21	0.18	0.0019	0.0206	0.0000	0.003
	MEAN+2SD	2759	2012	95	2.40	0.0060	0.0605	0.0050	0.025
	2/19/98	**2394**	**1385**	**92**	**1.7**	**0.001**	**0.009**	**0.003**	**0.02**
	3/18/98	**2499**	**1370**	**87**	**1.8**	**0.004**	**0.011**	**<0.003**	**0.013**
	4/22/98	**2541**	**1577**	**154**	**1.7**	**0.0007**	**0.01**	**<0.003**	**0.023**
	5/6/98	**2597**	**1157**	**143**	**1.8**	**0.0003**	**0.009**	**<0.003**	**0.011**
	1998 Mean	**2508**	**1372**	**119**	**1.8**	**0.0015**	**0.010**	**0.003**	**0.017**
DH-9	5/10/96	566	254	40	1.111	0.005	0.0096	0.0083	0.062
	11/8/96	661	278	57	1.18	0.003	0.012	0.009	0.069
	5/7/97	588	242	48	0.971	0.003	0.008	0.006	0.08
	11/6/97	1382	652	123	1.092	0.012	0.016	0.008	0.521
	MIN	566	242	40	0.97	0.003	0.008	0.006	0.06
	MAX	1382	652	123	1.18	0.012	0.016	0.009	0.52
	MEAN	799	357	67	1.09	0.0058	0.0114	0.0078	0.18
	STD DEV	391	198	38	0.09	0.0043	0.0035	0.0013	0.23
	MEAN+2SD	1580	752	143	1.26	0.0143	0.0184	0.0104	0.63
	2/20/98	**2026**	**1058**	**244**	**0.93**	**0.03**	**0.024**	**0.011**	**1.6**
	3/18/98	**1573**	**744**	**174**	**1.3**	**0.034**	**0.019**	**0.005**	**1.7**
	4/22/98	**1116**	**557**	**121**	**1.3**	**0.019**	**0.012**	**0.005**	**1.1**
	5/7/98	**1168**	**462**	**125**	**1.5**	**0.022**	**0.014**	**0.003**	**1.2**
	1998 Mean	**1471**	**705**	**166**	**1.3**	**0.026**	**0.017**	**0.006**	**1.4**
PPC-5	5/9/96	171	51	4.6	0.009	0.001	0.004	0.005	0.109
	11/7/96	189	60	3.7	0.014	0.001	0.004	0.005	0.064
	5/5/97	129	38	1	0.005	0.001	0.004	0.005	0.096
	11/4/97	181	50	3	0.005	0.001	0.004	0.005	0.079
	MIN	129	38	1	0.01	0.001	0.004	0.005	0.06
	MAX	189	60	4.6	0.01	0.001	0.004	0.005	0.11
	MEAN	168	50	3	0.01	0.0010	0.0040	0.0050	0.09
	STD DEV	27	9	2	0.00	0.0000	0.0000	0.0000	0.02
	MEAN+2SD	221	68	6	0.02	0.0010	0.0040	0.0050	0.13
	2/19/98	**216**	**49**	**3**	**0.005**	**0.0002**	**0.002**	**0.003**	**0.052**
PPC-7	5/9/96	176	49	4.2	0.005	0.005	0.0046	0.005	0.13
	11/7/96	204	56	3.6	0.014	0.001	0.004	0.005	0.078
	5/5/97	140	34	2	0.006	0.001	0.004	0.005	0.11
	11/4/97	179	47	3	0.007	0.001	0.004	0.005	0.093
	MIN	140	34	2	0.01	0.001	0.004	0.005	0.08
	MAX	204	56	4.2	0.01	0.005	0.0046	0.005	0.13
	MEAN	175	47	3	0.01	0.0020	0.0042	0.0050	0.10
	STD DEV	26	9	1	0.00	0.0020	0.0003	0.0000	0.02
	MEAN+2SD	227	65	5	0.02	0.0060	0.0048	0.0050	0.15
	2/19/98	**211**	**49**	**4**	**0.005**	**0.0003**	**0.002**	**0.003**	**0.057**
Plant Water	**2/20/98**	**2282**	**1255**	**228**	**3.2**	**5.2**	**0.05**	**0.016**	**5.8**
	6/3/98	**1891**	**788**	**229**	**0.032**	**5.9**	**0.034**	**0.71**	**2.7**

0.022 box around value indicates result is over the 95% confidence value

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East Helena area monitoring wells show water level trends similar to those on the lower plant site. Monitoring wells EH-50, EH-53, EH-54, EH-60, EH-61 and EH-62 all exhibited decreases in water levels ranging from 1.53 to 3.72 feet through April 1998. However, seasonal fluctuations in groundwater levels are typical for this area and the observed fluctuations appear to be within the normal seasonal range. Water level elevations in offsite monitoring wells measured during May 1998 were essentially the same as those reported during May 1997 Post RI/FS Monitoring.

4.2 WATER QUALITY ANALYSES

The monitoring wells sampled during this investigation have been used for monitoring purposes at the Asarco East Helena Smelter for a minimum of the last ten years as part of the RI/FS. As such, a large database exists for these wells. However, several remediation projects have been completed during the monitoring period on the plant site up through and including 1995. In the meeting held on March 3, 1998, EPA noted that effects from remedial activities prior to 1995 could potentially mask groundwater effects from recent plant water losses. Because of this, it was agreed that only results from spring and fall water quality monitoring events in 1996 and 1997 would be used as baseline data for the plant water loss evaluation.

Water quality samples were collected at the monitoring sites listed in Table 3-2 and were analyzed for the parameters listed in Table 3-3. Analytical results are in Appendix A and temporal concentration graphs for arsenic, cadmium, copper, lead and zinc during the 1996 to May 1998 period are presented in Appendix B.

Statistical summaries of indicator parameters (TDS, sulfate, chloride, arsenic, cadmium, copper, lead and zinc) are in Table 4-1. These parameters are typically elevated in plant water however, they may or may not exceed ambient groundwater concentrations beneath portions of the plant site due to historical site conditions. Cadmium, and to a lesser extent

zinc, were found to be the most distinctive indicators of plant water effects relative to ambient groundwater beneath the plant site. As shown in Table 4-1, concentrations of arsenic, cadmium, and zinc in plant water in February were 3.2 mg/L, 5.2 mg/L and 5.8 mg/L, respectively. Basic statistics, including minimum, maximum, mean standard deviation and mean plus two times the standard deviation (approximate 95% confidence limit), were calculated for the 1996/1997 data set. The mean plus two standard deviations or 95% confidence limits represent the range of normal variation. Table 4-1 compares 1998 sample results to the two standard deviation range of the 1996/1997 data set. Indicator concentrations that are higher than the mean plus two standard deviations of the 1996/1997 data set are considered outside of the normal range of variation, and are therefore suspected indicators of plant water impacts to groundwater. However, it is important to note that although a value might be statistically above the 95% confidence value, the actual concentration change may be very small (i.e., for parameters which were previously present at very low concentrations). As shown in Table 4-1, all of the sampling sites, with the exception of DH-24 and DH-27, and the surface water sites PPC-5 and PPC-7, had at least one indicator parameter exceed the 95% confidence limit. In particular, for the first sampling round in February 1998, cadmium was above the 95% confidence value at wells DH-9, DH-21, DH-23 and DH-28, and zinc was above the 95% confidence value at wells DH-9, DH-10A, DH-16, and DH-23.

Water quality at most of the groundwater monitoring sites improved considerably after the initial February 1998 sampling event. The water quality improvement is coincident with general water level declines throughout the area, and is particularly evident in wells DH-6, DH-21, DH-23 and DH-28. The indicator parameters for these wells show a general trend of decreasing concentrations since February and all of the parameters were within the 95% confidence limits of the 1996/1997 data set by May 1988. Indicator parameters for well DH-12 also showed a pattern of decreasing concentrations, although concentrations of cadmium and lead remained slightly higher than the 95% confidence interval for the 1996/1997 data set for this well.

Some downgradient wells, (DH-9 and DH-10A) showed a trend of concentration increases for arsenic after the initial February sampling event through May (see Table 4-1 and Appendix B). Specifically, arsenic concentrations were in excess of the 95% confidence value at wells DH-9 and DH-10A during March 1998 and April 1998, respectively. In addition, concentrations of cadmium and zinc for well DH-9 also are elevated above the 95% confidence value throughout the February through May 1998 sampling period. Spring 1998 sampling results for the Post RI/FS East Helena monitoring sites are not yet complete, but preliminary results show no increase in arsenic or metals in downgradient monitoring wells EH-51 and EH-52.

Concentrations of zinc in well DH-16/17 remain elevated above the 1996/1997 95% confidence interval for this well and have had minimal change from the initial February sampling event through May 1998.

Arsenic speciation performed on the plant site water indicates that arsenic is predominantly present in the +5 (As V) oxidation state. As (V) typically has a greater affinity for adsorption than As(III) and consequently is less mobile in groundwater.

Concentrations of arsenic and metals at both Prickly Pear Creek monitoring sites (PPC-5 and PPC-7) were below detection or within normal ranges and there were no increases in indicator parameters between upgradient and downgradient stations. This is consistent with groundwater/surface water relationships on the site. Prickly Pear Creek is hydrologically above the groundwater system downgradient of the plant site and typically loses water to the groundwater system over this reach. Water quality data from the first round of sampling confirmed the absence of impacts to Prickly Pear Creek.

5. CONCLUSIONS

5.1 ONSITE WELLS

Based on the well sampling results, it appears that the plant water loss had some initial impact on groundwater levels in the central plant area. The initial increase in water levels in February 1998 and the subsequent decrease from February 13-18, 1998 at DH-9, DH-12, DH-13, DH-21, DH-23 and DH-28 after the underground pressurized system was shutdown is a likely indication of the general areas influenced by plant water pipeline failure. By May 1998 water levels in the central plant site area appear to be within the normal historical range for the area and time of year. The remaining areas of the plant site also appear to be within normal historical ranges despite elevated regional water table conditions in the fall of 1997.

The most pronounced water quality changes were noted in the central plant site area near DH-9, DH-12, DH-13, DH-21, DH-23 and DH-28. Elevated levels of arsenic, cadmium and zinc and to a lesser extent TDS, sulfate and chloride were initially observed in this area. Smaller but statistically significant water quality changes were also observed in downgradient plant site monitoring wells (DH-16, DH-10A, DH-6).

Cadmium and zinc appear to be the parameters most indicative of plant water leakage in groundwater as these parameters are, on a daily basis, generally higher for plant water than in groundwater. Changes in excess of two standard deviations were initially observed in both these parameters at DH-9 and DH-23. These wells are completed in an area where perched groundwater is present and where the effects of plant water leakage would be the most pronounced.

Monitoring wells DH-12, DH-13, DH-21 and DH-28 are also in the central plant site area, but are completed in the shallow alluvial aquifer. Concentration changes were also observed in selected parameters in these wells, however, the parameters showing the largest changes were at higher concentrations than plant water. Since the parameters in question have been elevated at each of these sites in the past, these changes are likely the result of high

groundwater levels in existing source areas rather than a direct effect of plant water leakage. The concentrations of zinc and cadmium at DH-12, DH-21 and DH-28 were significantly less than plant water.

By May 1998, residual water quality changes (values above the 95% confidence limits) are only evident for selected parameters at DH-9, DH-10A, DH-12 and DH-16. Cadmium and lead remain elevated at DH-12 but show a trend of decreasing concentrations. DH-12 is the only well which shows a consistent lead anomaly. Because of its limited mobility in groundwater, lead typically only occurs at significant concentrations in source areas. During the course of this investigation, the surface seal on the casing at DH-12, a flush mount well, was found to be damaged and was subsequently repaired. Asarco has proposed to redevelop this well (as described in Asarco's June 26, 1998 letter to EPA) to determine whether surface materials may have been introduced to the well and are influencing water quality results at this location.

Concentrations of zinc for DH-16 and DH-9 remain elevated and have changed little since the February 1998 sampling event. Consistent elevated zinc concentrations in this area may be related to higher than normal groundwater conditions in the former Zinc Plant Area. Since groundwater levels have returned to normal ranges, a decrease in zinc concentration is expected to follow.

Well DH-10A shows a pattern of increasing arsenic concentrations after February 1998 with the highest values observed in April 1998. The May 1998 value showed a slight decrease, but remained above the 95% confidence limit. However, none of the plant water indicator parameters (cadmium, zinc, TDS, sulfate) are elevated at DH-10A. Since other indicator values do not show evidence of plant water, elevated arsenic in DH-10A may have resulted from high water table conditions in an existing upgradient source area. If this is the case, arsenic concentrations in DH-10A should continue to decline to preexisting (pre-February 1998) levels.

With the exception of the selected sites and parameters discussed above, initial effects of plant water leakage have dissipated and water quality within the plant site area appears to be largely within historical concentration levels.

5.2 OFFSITE WELLS

A seasonal water level decline was observed in all of the offsite monitoring wells during the period of investigation. Observed fluctuations appear to be within the normal seasonal range and May 1998 water levels appear to be consistent with those reported during May 1997.

As previously discussed, the analyses for the post-RI/FS May 1998 monitoring results have not been finalized or validated, but preliminary data show no anomalous changes in indicator parameters at downgradient East Helena monitoring well sites.

5.3 PRICKLY PEAR CREEK

No water quality changes were observed in Prickly Pear Creek during the initial sampling round and none are anticipated since Prickly Pear Creek does not receive recharge from the groundwater system in the area where residual water quality effects have been noted.

In summary, transient water quality effects have been identified on the plant site which may be related directly or indirectly to the plant water leakage. These water quality changes appear to be limited to the immediate plant site area. No water quality impacts have been observed in surface water or offsite wells, and no long-term impacts are expected.

6. RECOMMENDATIONS

Asarco has performed several actions since February 1998 to ensure further protection of the environment. An aboveground pipeline has replaced the majority of the underground pressurized pipeline and Asarco is in the process of installing flow meters in the remaining three underground low pressure supply lines in the plant water circuit to directly monitor flows. Asarco is prepared to continue supplemental groundwater monitoring to detect any residual effects of plant water leakage. The scope for monitoring would consist of the following:

- Continued supplemental monitoring (water level measurement and water quality sampling) at wells near the site boundary where effects were noted (based on May 1998 results). These wells are DH-9, DH-12, DH-16, and DH-10A.
- Monitoring of downgradient wells EH-52, DH-6, and DH-24 to confirm long-term water quality trends.

Additional sampling would be conducted in August 1998 and then again in November 1998, in conjunction with the post-RI/FS monitoring program. A review of results will be conducted in early 1999, to assess any residual effects of the plant water leakage. If the results show that parameter concentrations have recovered to previous ranges (less than two standard deviations from the 1996/1997 data set), the supplemental plant water monitoring program would be discontinued and long-term monitoring of these sites would be continued as required by the Post RI/FS long-term monitoring program.

APPENDIX A

DATA VALIDATION REPORT AND WATER QUALITY DATA

Hydrometrics, Inc.®

Consulting Scientists, Engineers & Contractors

MEMORANDUM

DATE: July 7, 1998

TO: Bill Thompson

FROM: Clare Bridge

SUBJECT: **Validation of Asarco East Helena Plant Water Release data collected from February 19 through June 3, 1998.**

Summary: The data collected to ascertain the nature and extent of contamination due to the plant water release are fully acceptable for these purposes.

In order to determine the quality of the data, the following steps were carried out.

- Laboratory QC Evaluation. Laboratory quality control samples were checked. Most laboratory QC samples were within control limits. The exceptions are listed in the following table.

Lab Batch	QC Type	Parameter	Analysis Date	Recovery	Type of Flag	Number of Flags	Possibility of
L980989	Matrix spike	Silver*	5/27/98	63%	J_4/UJ_4	7	Low bias
L981158	LCS	Selenium	06/10/98	123%	J_2	1	High bias

* The analyst noted that the low recovery on the silver spike was due to matrix interference. The spike and the silver results that were flagged were analyzed by FAA (method 272.2).

- Field Duplicate Evaluation. A field duplicate was submitted each month. All duplicate parameters were found to be within control limits with the exception of manganese for the duplicate submitted with the February samples.

Site	Sample/Duplicate Number	Date	Parameter	Sample/Duplicate Result	Evaluation	Number of Flags*
DH-28	ASEH-9802-110/ 111	2/20/98	Manganese	0.15/ 0.19 ppm	23.5% RPD	5

* Manganese results less than 0.3 ppm were flagged (J_4/UJ_4) in order to indicate a possible lack of reproducibility.

TABLE 1.

DATA VALIDATION CODES AND DEFINITIONS

CODE		DEFINITION
J	-	The associated numerical value is an estimated quantity because quality control criteria were not met. Subscripts for the "J" qualifier: 2 - Calibration range exceeded or significant deviation from known value. Possible bias. 3 - Holding time not met. Indicates low bias. 4 - Other QC outside control limits. 5 - Quality control sample was omitted. (Not an EPA code.)
UJ	-	The material was analyzed for, but was not detected above the associated value. 1 Blank contamination. Indicates possible high bias and/or false positive. 2 - Calibration range exceeded or significant deviation from known value. Possible bias. 3 - Holding time not met. Indicates low bias. 4 - Other QC outside control limits. 5 - Quality control sample was omitted. (Not an EPA code.)
R	-	Quality control indicates that the data are unusable (compound may or may not be present). Resampling and/or reanalysis is necessary for verification.
A	-	Anomalous data. No apparent explanation for discrepancy in data. (Not an EPA code.)

Table 2. Summary of Flagged Data
East Helena Waterline Release Data, February-June 1998

Site	Sample No	Date	Parameter	Result	Flag	Bias	Reason for Flag
DH-6	ASEH 9802-103	02/19/98	MANGANESE (MN)(DIS)	<0.005	UJ4		Field duplicate RPD = 23.5%
DH-9	ASEH 9802-105	02/20/98	MANGANESE (MN)(DIS)	0.048	J4		Field duplicate RPD = 23.5%
DH-16	ASEH-9805-107	05/11/98	SILVER (AG)(DIS)	<0.003	UJ4	-37%	Matrix spike recovery 63%
DH-21	ASEH 9802-109	02/20/98	MANGANESE (MN)(DIS)	0.013	J4		Field duplicate RPD = 23.5%
DH-21D	ASEH-9805-110	05/12/98	SILVER (AG)(DIS)	0.008	J4	-37%	Matrix spike recovery 63%
DH-21S	ASEH-9805-111	05/12/98	SILVER (AG)(DIS)	0.007	J4	-37%	Matrix spike recovery 63%
DH-24	ASEH-9805-105	05/11/98	SILVER (AG)(DIS)	<0.003	UJ4	-37%	Matrix spike recovery 63%
DH-24	ASEH-9805-106	05/11/98	SILVER (AG)(DIS)	<0.003	UJ4	-37%	Matrix spike recovery 63%
DH-28	ASEH 9802-110	02/20/98	MANGANESE (MN)(DIS)	0.15	J4		Field duplicate RPD = 23.5%
DH-28	ASEH 9802-111	02/20/98	MANGANESE (MN)(DIS)	0.19	J4		Field duplicate RPD = 23.5%
DH-28D	ASEH-9805-109	05/11/98	SILVER (AG)(DIS)	<0.003	UJ4	-37%	Matrix spike recovery 63%
DH-28S	ASEH-9805-108	05/11/98	SILVER (AG)(DIS)	<0.003	UJ4	-37%	Matrix spike recovery 63%
PLANT	ASEH-9806-100	6/3/98	SELENIUM (SE)(DIS)	0.23	J2	+23%	LCS recovery 123%

TABLE OF CONTENTS BY SITE TYPE

Page	Site Code	Site Name	Site Type	Elevation MP	Well Depth
1	DH-6	DH-6	Groundwater		
1	DH-9	DH-9	Groundwater		
3	DH-10A	DH-10A	Groundwater		
3	DH-12	DH-12	Groundwater		
4	DH-16	DH-16	Groundwater		
5	DH-21	DH-21	Groundwater		
6	DH-21D	DH-21 DEEP	Groundwater		
6	DH-21S	DH-21 SHALLOW	Groundwater		
7	DH-23	DH-23	Groundwater		
7	DH-24	DH-24	Groundwater		
8	DH-27	DH-27	Groundwater		
9	DH-28	DH-28	Groundwater		
9	DH-28D	DH-28 DEEP	Groundwater		
9	DH-28S	DH-28 SHALLOW	Groundwater		
10	PLANT	PLANT WATER	Plant Process Fluids		
11	PPC-5	PPC-5	Surface Water		
11	PPC-7	PPC-7	Surface Water		

DRAFT

ANALYSES SUMMARY REPORT

-- SAMPLE TYPE: GROUNDWATER --

SITE CODE	DH-6	DH-6	DH-6	DH-6	DH-9	
SAMPLE DATE	02/19/98	03/18/98	04/22/98	05/06/98	02/20/98	
SAMPLE TIME	16:00	10:45	07:40	15:35	09:45	
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	
LAB NUMBER	L980404-4	L980601-2	L980844-1	L980941-1	L980404-6	
SAMPLE NUMBER	ASEH 9802-103	ASEH-9803-101	ASEH-9804-100	ASEH-9805-100	ASEH 9802-105	
-- PHYSICAL PARAMETERS --						
DEPTH TO WATER LEVEL (FEET)	11.7	13.29	14.23	14.12	8.23	
OXYGEN (O) (FLD) DIS		2.04	2.53	2.6		
PH (FLD)	7.59	6.86	7.21	6.92	6.85	
PH	7.4		7.4	7.4	7.3	
SC (UMHOS/CM AT 25 C)	3070.0		3320.0	3400.0	2730.0	
SC (UMHOS/CM AT 25 C) (FLD)	2990.0	2890.0	2570.0	3060.0	2590.0	
TDS (MEASURED AT 180 C)	2394.0	2499.0	2541.0	2597.0	2026.0	
WATER TEMPERATURE (C) (FLD)	10.5	10.3	10.5	12.6	7.4	
-- MAJOR CONSTITUENTS --						
CALCIUM (CA) DIS	186.0				283.0	
MAGNESIUM (MG) DIS	26.0				27.0	
SODIUM (NA) DIS	456.0				271.0	
POTASSIUM (K) DIS	178.0				79.0	
BICARBONATE (HCO3)	210.0				112.0	
SULFATE (SO4)	1385.0	1370.0	1577.0	1257.0	1058.0	
CHLORIDE (CL)	92.0	87.0	154.0	143.0	244.0	
-- METALS & MINOR CONSTITUENTS --						
ARSENIC (AS) DIS	1.7	1.8	1.7	1.8	0.93	
BARIUM (BA) DIS	0.082	0.085	0.092	0.1	0.097	
CADMIUM (CD) DIS	0.001	0.0004	0.0007	0.0003	0.03	
CHROMIUM (CR) DIS	<0.002	0.002	<0.001	0.004	<0.001	
COPPER (CU) DIS	0.009	0.011	0.01	0.009	0.024	
IRON (FE) DIS	<0.05				0.062	
LEAD (PB) DIS	<0.003	<0.003	<0.003	<0.003	0.011	
MANGANESE (MN) DIS	<0.005 UJ4				0.048	J4
SELENIUM (SE) DIS	0.23	0.16	0.17	0.2	0.079	
SILVER (AG) DIS	<0.001	<0.003	<0.003	<0.003	<0.001	
ZINC (ZN) DIS	0.02	0.013	0.023	0.011	1.6	

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT.Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
R:Rejected.

-- SAMPLE TYPE: GROUNDWATER --

SITE CODE	DH-9	DH-9	DH-9	DH-9	DH-9
SAMPLE DATE	03/18/98	03/18/98	04/22/98	04/22/98	05/07/98
SAMPLE TIME	12:00	12:15	12:15	12:30	09:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	L980601-3	L980601-4	L980844-5	L980844-6	L980941-3
REMARKS		DUPLICATE		DUPLICATE	
SAMPLE NUMBER	ASEH-9803-102	ASEH-9803-103	ASEH-9804-104	ASEH-9804-105	ASEH-9805-102
-- PHYSICAL PARAMETERS --					
DEPTH TO WATER LEVEL (FEET)	12.0	NO MEAS	11.2	NO MEAS	11.11
OXYGEN (O) (FLD) DIS	2.44	NO MEAS	8.82	NO MEAS	7.65
PH (FLD)	6.75	NO MEAS	6.65	NO MEAS	6.96
PH			7.5	7.5	7.3
SC (UMHOS/CM AT 25 C)			1512.0	1520.0	1648.0
SC (UMHOS/CM AT 25 C) (FLD)	2020.0	NO MEAS	1099.0	NO MEAS	1567.0
TDS (MEASURED AT 180 C)	1611.0	1573.0	1116.0	1107.0	1168.0
WATER TEMPERATURE (C) (FLD)	10.8	NO MEAS	19.4	NO MEAS	9.5
-- MAJOR CONSTITUENTS --					
SULFATE (SO4)	777.0	744.0	557.0	567.0	462.0
CHLORIDE (CL)	174.0	182.0	121.0	118.0	125.0
-- METALS & MINOR CONSTITUENTS --					
ARSENIC (AS) DIS	1.3	1.3	1.3	1.2	1.5
BARIUM (BA) DIS	0.081	0.083	0.056	0.059	0.071
CADMIUM (CD) DIS	0.034	0.034	0.019	0.018	0.022
CHROMIUM (CR) DIS	0.002	<0.001	<0.001	<0.001	0.001
COPPER (CU) DIS	0.02	0.019	0.012	0.013	0.014
LEAD (PB) DIS	0.003	0.005	0.005	0.006	0.003
SELENIUM (SE) DIS	0.057	0.057	0.02	0.019	0.022
SILVER (AG) DIS	<0.003	<0.003	<0.003	<0.003	<0.003
ZINC (ZN) DIS	1.8	1.7	1.1	1.0	1.2

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance; R:Rejected.

-- SAMPLE TYPE: GROUNDWATER --

SITE CODE	DH-10A	DH-10A	DH-10A	DH-10A	DH-12
SAMPLE DATE	02/19/98	03/18/98	04/22/98	05/07/98	02/20/98
SAMPLE TIME	14:30	09:30	09:00	08:30	13:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	L980404-3	L980601-1	L980844-2	L980941-2	L980404-9
SAMPLE NUMBER	ASEH 9802-102	ASEH-9803-100	ASEH-9804-101	ASEH-9805-101	ASEH 9802-108
-- PHYSICAL PARAMETERS --					
DEPTH TO WATER LEVEL (FEET)	5.36	6.41	6.71	6.11	23.24
OXYGEN (O) (FLD) DIS		1.62	3.54	1.58	
PH (FLD)	6.9	7.09	7.38	6.96	6.81
PH	7.6		7.6	7.5	7.1
SC (UMHOS/CM AT 25 C)	3170.0		1047.0	702.0	4290.0
SC (UMHOS/CM AT 25 C) (FLD)	3150.0	3200.0	880.0	694.0	3940.0
TDS (MEASURED AT 180 C)	2374.0	2484.0	706.0	453.0	3466.0
WATER TEMPERATURE (C) (FLD)	6.7	6.1	7.7	7.0	10.1
-- MAJOR CONSTITUENTS --					
CALCIUM (CA) DIS	164.0				252.0
MAGNESIUM (MG) DIS	21.0				99.0
SODIUM (NA) DIS	468.0				771.0
POTASSIUM (K) DIS	243.0				27.0
BICARBONATE (HCO3)	221.0				522.0
SULFATE (SO4)	1337.0	1356.0	327.0	148.0	1911.0
CHLORIDE (CL)	135.0	146.0	25.0	14.0	170.0
-- METALS & MINOR CONSTITUENTS --					
ARSENIC (AS) DIS	1.2	1.2	3.8	3.3	24.0
BARIUM (BA) DIS	0.13	0.14	0.038	0.03	0.031
CADMIUM (CD) DIS	0.0027	0.0008	0.0003	0.0004	0.0013
CHROMIUM (CR) DIS	<0.001	<0.001	<0.001	0.002	<0.002
COPPER (CU) DIS	0.01	0.01	0.004	0.006	0.007
IRON (FE) DIS	<0.05				11.0
LEAD (PB) DIS	<0.003	<0.003	<0.003	<0.003	<0.003
MANGANESE (MN) DIS	2.3				8.5
SELENIUM (SE) DIS	0.2	0.065	0.014	0.024	0.069
SILVER (AG) DIS	<0.001	<0.003	<0.003	<0.003	<0.001
ZINC (ZN) DIS	0.029	0.017	0.011	0.013	0.65

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
R:Rejected.

-- SAMPLE TYPE: GROUNDWATER --

SITE CODE	DH-12	DH-12	DH-12	DH-16	DH-16
SAMPLE DATE	03/18/98	04/22/98	05/07/98	02/20/98	03/18/98
SAMPLE TIME	17:00	15:45	11:30	10:45	16:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	L980601-8	L980844-10	L980941-5	L980404-7	L980601-7
SAMPLE NUMBER	ASEH-9803-107	ASEH-9804-109	ASEH-9805-104	ASEH 9802-106	ASEH-9803-106
-- PHYSICAL PARAMETERS --					
DEPTH TO WATER LEVEL (FEET)	26.04	27.48	27.9	26.88	28.97
OXYGEN (O) (FLD) DIS	1.12	1.92	1.33		1.04
PH (FLD)	7.19	7.12	6.72	7.26	6.53
PH		7.1	7.1	6.5	
SC (UMHOS/CM AT 25 C)		955.0	858.0	1876.0	
SC (UMHOS/CM AT 25 C) (FLD)	1768.0	958.0	836.0	1726.0	2130.0
TDS (MEASURED AT 180 C)	1312.0	697.0	551.0	1369.0	1744.0
WATER TEMPERATURE (C) (FLD)	10.0	12.8	10.5	9.8	10.4
-- MAJOR CONSTITUENTS --					
CALCIUM (CA) DIS				89.0	
MAGNESIUM (MG) DIS				30.0	
SODIUM (NA) DIS				264.0	
POTASSIUM (K) DIS				20.0	
BICARBONATE (HCO3)				140.0	
SULFATE (SO4)	644.0	280.0	187.0	765.0	1012.0
CHLORIDE (CL)	48.0	29.0	17.0	73.0	116.0
-- METALS & MINOR CONSTITUENTS --					
ARSENIC (AS) DIS	17.0	12.0	12.0	35.0	13.0
BARIUM (BA) DIS	0.037	0.034	0.032	0.063	0.029
CADMIUM (CD) DIS	0.06	0.054	0.041	0.0011	0.0006
CHROMIUM (CR) DIS	<0.001	<0.001	0.002	<0.002	<0.001
COPPER (CU) DIS	0.014	0.016	0.008	0.003	0.004
IRON (FE) DIS				17.0	
LEAD (PB) DIS	0.044	0.042	0.041	<0.003	<0.003
MANGANESE (MN) DIS				7.6	
SELENIUM (SE) DIS	0.013	0.05	0.035	0.064	0.01
SILVER (AG) DIS	<0.003	<0.003	<0.003	<0.001	<0.003
ZINC (ZN) DIS	0.38	0.28	0.26	4.1	3.7

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance; R:Rejected.

-- SAMPLE TYPE: GROUNDWATER --

SITE CODE	DH-16	DH-16		DH-21		DH-21
SAMPLE DATE	04/22/98	05/11/98		02/20/98		03/18/98
SAMPLE TIME	11:30	11:00		14:30		18:00
LAB	TSC-SLC	TSC-SLC		TSC-SLC		TSC-SLC
LAB NUMBER	L980844-4	L980989-3		L980404-10		L980601-9
SAMPLE NUMBER	ASEH-9804-103	ASEH-9805-107		ASEH 9802-109		ASEH-9803-108
-- PHYSICAL PARAMETERS --						
DEPTH TO WATER LEVEL (FEET)	28.63	28.88		17.55		20.22
OXYGEN (O) (FLD) DIS	2.32	1.19				1.05
PH (FLD)	6.12	5.96		11.52		10.78
PH	6.1			10.6		
SC (UMHOS/CM AT 25 C)	2120.0			8270.0		
SC (UMHOS/CM AT 25 C) (FLD)	1573.0	1680.0		7480.0		9940.0
TDS (MEASURED AT 180 C)	1560.0	1384.0		6290.0		9213.0
WATER TEMPERATURE (C) (FLD)	14.9	13.3		15.1		12.7
-- MAJOR CONSTITUENTS --						
CALCIUM (CA) DIS				<5.0		
MAGNESIUM (MG) DIS				<5.0		
SODIUM (NA) DIS				2001.0		
POTASSIUM (K) DIS				33.0		
BICARBONATE (HCO3)				366.0		
SULFATE (SO4)	968.0	747.0		2278.0		3155.0
CHLORIDE (CL)	79.0	55.0		421.0		422.0
-- METALS & MINOR CONSTITUENTS --						
ARSENIC (AS) DIS	31.0	36.0		300.0		586.0
BARIUM (BA) DIS	0.052	0.031		0.029		0.038
CADMIUM (CD) DIS	0.0005	<0.001		0.022		0.003
CHROMIUM (CR) DIS	<0.001	0.002		<0.01		<0.001
COPPER (CU) DIS	0.002	0.002		0.063		0.027
IRON (FE) DIS				0.17		
LEAD (PB) DIS	<0.003	<0.003		0.014		0.008
MANGANESE (MN) DIS				0.013	J4	
SELENIUM (SE) DIS	0.028	0.01		2.8		5.4
SILVER (AG) DIS	<0.003	<0.003	UJ4	<0.001		0.006
ZINC (ZN) DIS	4.7	4.1		0.039		<0.01

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
R:Rejected.

-- SAMPLE TYPE: GROUNDWATER --

SITE CODE	DH-21D	DH-21D		DH-21S	DH-21S	
SAMPLE DATE	04/22/98	05/12/98		04/22/98	05/12/98	
SAMPLE TIME	15:00	10:40		14:30	11:10	
LAB	TSC-SLC	TSC-SLC		TSC-SLC	TSC-SLC	
LAB NUMBER	L980844-9	L980989-6		L980844-8	L980989-7	
SAMPLE NUMBER	ASEH-9804-108	ASEH-9805-110		ASEH-9804-107	ASEH-9805-111	
-- PHYSICAL PARAMETERS --						
DEPTH TO WATER LEVEL (FEET)	21.01	21.12		NO MEAS	21.12	
OXYGEN (O) (FLD) DIS	2.04	2.05		NO MEAS	2.69	
PH (FLD)	11.05	11.18		NO MEAS	11.33	
PH	11.0			11.0		
SC (UMHOS/CM AT 25 C)	13200.0			13050.0		
SC (UMHOS/CM AT 25 C) (FLD)	7890.0	9630.0		9890.0	10320.0	
TDS (MEASURED AT 180 C)	8420.0	7896.0		8712.0	8183.0	
WATER TEMPERATURE (C) (FLD)	16.4	15.2		NO MEAS	14.6	
-- MAJOR CONSTITUENTS --						
SULFATE (SO4)	2995.0	2317.0		3150.0	2460.0	
CHLORIDE (CL)	367.0	369.0		403.0	387.0	
-- METALS & MINOR CONSTITUENTS --						
ARSENIC (AS) DIS	528.0	441.0		552.0	468.0	
BARIUM (BA) DIS	0.035	0.038		0.036	0.047	
CADMIUM (CD) DIS	0.005	0.003		0.005	0.003	
CHROMIUM (CR) DIS	<0.001	0.13		0.001	0.14	
COPPER (CU) DIS	0.039	0.052		0.044	0.044	
LEAD (PB) DIS	0.015	0.013		0.016	0.017	
SELENIUM (SE) DIS	4.6	6.9		4.9	7.2	
SILVER (AG) DIS	0.007	0.008	J4	0.009	0.007	J4
ZINC (ZN) DIS	0.012	0.01		0.01	0.011	

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
R:Rejected.

-- SAMPLE TYPE: GROUNDWATER --

SITE CODE	DH-23	DH-23	DH-23	DH-23	DH-24
SAMPLE DATE	02/20/98	03/18/98	04/22/98	05/07/98	02/20/98
SAMPLE TIME	08:30	13:10	14:00	10:40	11:45
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	L980404-5	L980601-5	L980844-7	L980941-4	L980404-8
SAMPLE NUMBER	ASEH 9802-104	ASEH-9803-104	ASEH-9804-106	ASEH-9805-103	ASEH 9802-107
-- PHYSICAL PARAMETERS --					
DEPTH TO WATER LEVEL (FEET)	11.62	12.0	11.95	11.95	26.16
OXYGEN (O) (FLD) DIS		1.43	3.78	4.8	
PH (FLD)	6.6	6.58	7.11	7.21	6.56
PH	7.4		7.6	7.8	6.0
SC (UMHOS/CM AT 25 C)	3200.0		2440.0	2150.0	1713.0
SC (UMHOS/CM AT 25 C) (FLD)	3030.0	2700.0	1800.0	1941.0	1615.0
TDS (MEASURED AT 180 C)	2440.0	2195.0	1769.0	1503.0	1352.0
WATER TEMPERATURE (C) (FLD)	7.5	7.5	12.0	9.5	11.7
-- MAJOR CONSTITUENTS --					
CALCIUM (CA) DIS	308.0				84.0
MAGNESIUM (MG) DIS	17.0				33.0
SODIUM (NA) DIS	371.0				159.0
POTASSIUM (K) DIS	88.0				17.0
BICARBONATE (HCO3)	111.0				54.0
SULFATE (SO4)	1308.0	1122.0	937.0	648.0	765.0
CHLORIDE (CL)	284.0	321.0	219.0	192.0	57.0
-- METALS & MINOR CONSTITUENTS --					
ARSENIC (AS) DIS	1.3	1.3	1.2	1.5	24.0
BARIUM (BA) DIS	0.046	0.052	0.043	0.041	0.023
CADMIUM (CD) DIS	1.7	1.2	0.47	0.47	0.21
CHROMIUM (CR) DIS	<0.001	0.001	<0.001	0.002	<0.002
COPPER (CU) DIS	0.056	0.052	0.031	0.033	0.009
IRON (FE) DIS	0.063				17.0
LEAD (PB) DIS	0.044	0.048	0.041	0.037	<0.003
MANGANESE (MN) DIS	1.9				12.0
SELENIUM (SE) DIS	0.077	0.056	0.032	0.053	0.04
SILVER (AG) DIS	<0.001	<0.003	<0.003	<0.003	<0.001
ZINC (ZN) DIS	5.0	4.1	1.7	1.4	8.3

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance; R:Rejected.

-- SAMPLE TYPE: GROUNDWATER --

SITE CODE	DH-24	DH-24	DH-24	DH-24	DH-27
SAMPLE DATE	03/18/98	04/22/98	05/11/98	05/11/98	02/20/98
SAMPLE TIME	14:30	10:00	09:30	10:00	16:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	L980601-6	L980844-3	L980989-1	L980989-2	L980404-13
REMARKS				DUPLICATE	
SAMPLE NUMBER	ASEH-9803-105	ASEH-9804-102	ASEH-9805-105	ASEH-9805-106	ASEH 9802-112
-- PHYSICAL PARAMETERS --					
DEPTH TO WATER LEVEL (FEET)	27.59	28.9	29.11	29.11	12.03
OXYGEN (O) (FLD) DIS	1.48	2.46	1.5	1.48	
PH (FLD)	6.05	5.85	5.64	5.6	7.62
PH		5.9			6.4
SC (UMHOS/CM AT 25 C)		1545.0			2560.0
SC (UMHOS/CM AT 25 C) (FLD)	1565.0	1233.0	1398.0	1390.0	2400.0
TDS (MEASURED AT 180 C)	1289.0	1172.0	1115.0	1146.0	1919.0
WATER TEMPERATURE (C) (FLD)	11.4	11.7	12.4	12.0	9.2
-- MAJOR CONSTITUENTS --					
CALCIUM (CA) DIS					115.0
MAGNESIUM (MG) DIS					21.0
SODIUM (NA) DIS					418.0
POTASSIUM (K) DIS					50.0
BICARBONATE (HCO3)					81.0
SULFATE (SO4)	729.0	728 0	568.0	641.0	1156.0
CHLORIDE (CL)	59.0	48.0	42.0	44.0	92.0
-- METALS & MINOR CONSTITUENTS --					
ARSENIC (AS) DIS	24.0	22.0	24.0	25.0	20.0
BARIUM (BA) DIS	0.036	0.033	0.016	0.016	0.016
CADMIUM (CD) DIS	0.19	0.22	0.22	0.23	0.0014
CHROMIUM (CR) DIS	<0.001	<0.001	0.002	0.002	<0.01
COPPER (CU) DIS	0.01	0.005	0.006	0.004	<0.005
IRON (FE) DIS					14.0
LEAD (PB) DIS	0.007	<0.003	0.004	0.005	<0.003
MANGANESE (MN) DIS					8.5
SELENIUM (SE) DIS	0.008	0.028	0.018	<0.01	0.02
SILVER (AG) DIS	<0.003	<0.003	<0.003 UJ4	<0.003 UJ4	<0.001
ZINC (ZN) DIS	8.6	8.2	8.3	8.4	2.1

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance; R:Rejected.

-- SAMPLE TYPE: GROUNDWATER --

SITE CODE	DH-28	DH-28	DH-28D	DH-28S
SAMPLE DATE	02/20/98	02/20/98	05/11/98	05/11/98
SAMPLE TIME	15:15	15:30	14:00	14:10
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	L980404-11	L980404-12	L980989-5	L980989-4
REMARKS		DUPLICATE		
SAMPLE NUMBER	ASEH 9802-110	ASEH 9802-111	ASEH-9805-109	ASEH-9805-108
-- PHYSICAL PARAMETERS --				
DEPTH TO WATER LEVEL (FEET)	18.33	NO MEAS	21.5	21.5
OXYGEN (O) (FLD) DIS			0.93	1.18
PH (FLD)	10.89	NO MEAS	9.91	10.16
PH	10.0	10.0		
SC (UMHOS/CM AT 25 C)	6500.0	6170.0		
SC (UMHOS/CM AT 25 C) (FLD)	6140.0	NO MEAS	4070.0	5280.0
TDS (MEASURED AT 180 C)	4885.0	4920.0	2864.0	3700.0
WATER TEMPERATURE (C) (FLD)	11.9	NO MEAS	13.6	14.5
-- MAJOR CONSTITUENTS --				
CALCIUM (CA) DIS	5.9	6.5		
MAGNESIUM (MG) DIS	5.6	5.7		
SODIUM (NA) DIS	1604.0	1409.0		
POTASSIUM (K) DIS	12.0	12.0		
BICARBONATE (HCO3)	443.0	412.0		
SULFATE (SO4)	1875.0	1979.0	1409.0	1411.0
CHLORIDE (CL)	188.0	184.0	145.0	145.0
-- METALS & MINOR CONSTITUENTS --				
ARSENIC (AS) DIS	222.0	217.0	122.0	146.0
BARIUM (BA) DIS	0.023	0.024	0.025	0.017
CADMIUM (CD) DIS	0.0079	0.0079	0.002	0.005
CHROMIUM (CR) DIS	<0.01	<0.01	<0.001	<0.001
COPPER (CU) DIS	<0.05	<0.05	0.004	0.031
IRON (FE) DIS	0.21	0.24		
LEAD (PB) DIS	<0.01	<0.01	<0.003	0.046
MANGANESE (MN) DIS	0.15 J4	0.19 J4		
SELENIUM (SE) DIS	1.2	1.2	0.72	0.95
SILVER (AG) DIS	<0.001	<0.001	<0.003 UJ4	<0.003 UJ4
ZINC (ZN) DIS	0.067	0.071	0.014	0.031

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
R:Rejected.

-- SAMPLE TYPE: PLANT PROCESS FLUIDS --

SITE CODE		PLANT	PLANT
SAMPLE DATE		02/20/98	06/03/98
SAMPLE TIME		17:00	10:00
LAB		TSC-SLC	TSC-SLC
LAB NUMBER		L980404-14	L981158-1
SAMPLE NUMBER		ASEH 9802-113	ASEH-9806-100
-- PHYSICAL PARAMETERS --			
OXYGEN (O) (FLD)	DIS		4.09
PH (FLD)		7.2	6.77
PH		7.4	7.6
SC (UMHOS/CM AT 25 C)		2980.0	2580.0
SC (UMHOS/CM AT 25 C) (FLD)		2780.0	2360.0
TDS (MEASURED AT 180 C)		2282.0	1891.0
WATER TEMPERATURE (C) (FLD)		12.5	21.4
-- MAJOR CONSTITUENTS --			
CALCIUM (CA)	DIS	277.0	
MAGNESIUM (MG)	DIS	14.0	
SODIUM (NA)	DIS	363.0	
POTASSIUM (K)	DIS	64.0	
BICARBONATE (HCO3)		104.0	
SULFATE (SO4)		1255.0	788.0
CHLORIDE (CL)		228.0	229.0
-- METALS & MINOR CONSTITUENTS --			
ARSENIC (AS)	DIS	3.2	0.032
ARSENIC +3			0.003
ARSENIC +5			0.025
BARIUM (BA)	DIS	0.06	0.085
CADMIUM (CD)	DIS	5.2	5.9
CHROMIUM (CR)	DIS	<0.001	0.0017
COPPER (CU)	DIS	0.05	0.034
IRON (FE)	DIS	<0.05	
LEAD (PB)	DIS	0.016	0.71
MANGANESE (MN)	DIS	2.6	
SELENIUM (SE)	DIS	0.2	0.23 J2
SILVER (AG)	DIS	<0.001	
ZINC (ZN)	DIS	5.8	2.7

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance; R:Rejected.

-- SAMPLE TYPE: SURFACE WATER --

SITE CODE	PPC-5	PPC-7
SAMPLE DATE	02/19/98	02/19/98
SAMPLE TIME	13:45	12:00
LAB	TSC-SLC	TSC-SLC
LAB NUMBER	L980404-2	L980404-1
SAMPLE NUMBER	ASEH 9802-101	ASEH 9802-100
-- PHYSICAL PARAMETERS --		
FLOW (cfs)	23.33	20.00
PH (FLD)	6.92	7.31
PH	7.9	7.9
SC (UMHOS/CM AT 25 C)	292.0	288.0
SC (UMHOS/CM AT 25 C) (FLD)	304.0	280.0
TDS (MEASURED AT 180 C)	216.0	211.0
WATER TEMPERATURE (C) (FLD)	5.6	4.0
-- MAJOR CONSTITUENTS --		
CALCIUM (CA) DIS	31.0	31.0
MAGNESIUM (MG) DIS	7.2	7.1
SODIUM (NA) DIS	15.0	14.0
POTASSIUM (K) DIS	<5.0	<5.0
BICARBONATE (HCO3)	112.0	105.0
SULFATE (SO4)	49.0	49.0
CHLORIDE (CL)	3.0	4.0
-- METALS & MINOR CONSTITUENTS --		
ARSENIC (AS) DIS	<0.005	<0.005
ARSENIC (AS) TOT	0.005	0.005
BARIUM (BA) DIS	0.025	0.025
BARIUM (BA) TOT	0.026	0.025
CADMIUM (CD) DIS	0.0002	0.0003
CADMIUM (CD) TOT	0.0003	0.0003
CHROMIUM (CR) DIS	<0.001	<0.001
CHROMIUM (CR) TOT	<0.001	<0.001
COPPER (CU) DIS	0.002	0.001
COPPER (CU) TOT	0.003	0.002
IRON (FE) DIS	0.087	0.076
IRON (FE) TOT	0.29	0.29
LEAD (PB) DIS	<0.003	<0.003
LEAD (PB) TOT	0.004	0.003
MANGANESE (MN) DIS	0.07	0.069
MANGANESE (MN) TOT	0.08	0.08
SELENIUM (SE) DIS	<0.001	<0.001
SELENIUM (SE) TOT	<0.001	<0.001
SILVER (AG) DIS	<0.001	<0.001
SILVER (AG) TOT	<0.001	<0.001
ZINC (ZN) DIS	0.052	0.057
ZINC (ZN) TOT	0.061	0.067

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance; R:Rejected.

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SAMPLE NUMBER ORDER

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11	ASEH 9802-101	L980404-2	02/19/98	PPC-5
3	ASEH 9802-102	L980404-3	02/19/98	DH-10A
1	ASEH 9802-103	L980404-4	02/19/98	DH-6
7	ASEH 9802-104	L980404-5	02/20/98	DH-23
1	ASEH 9802-105	L980404-6	02/20/98	DH-9
4	ASEH 9802-106	L980404-7	02/20/98	DH-16
7	ASEH 9802-107	L980404-8	02/20/98	DH-24
3	ASEH 9802-108	L980404-9	02/20/98	DH-12
5	ASEH 9802-109	L980404-10	02/20/98	DH-21
9	ASEH 9802-110	L980404-11	02/20/98	DH-28
9	ASEH 9802-111	L980404-12	02/20/98	DH-28
8	ASEH 9802-112	L980404-13	02/20/98	DH-27
10	ASEH 9802-113	L980404-14	02/20/98	PLANT
3	ASEH-9803-100	L980601-1	03/18/98	DH-10A
1	ASEH-9803-101	L980601-2	03/18/98	DH-6
2	ASEH-9803-102	L980601-3	03/18/98	DH-9
2	ASEH-9803-103	L980601-4	03/18/98	DH-9
7	ASEH-9803-104	L980601-5	03/18/98	DH-23
8	ASEH-9803-105	L980601-6	03/18/98	DH-24
4	ASEH-9803-106	L980601-7	03/18/98	DH-16
4	ASEH-9803-107	L980601-8	03/18/98	DH-12
5	ASEH-9803-108	L980601-9	03/18/98	DH-21
1	ASEH-9804-100	L980844-1	04/22/98	DH-6
3	ASEH-9804-101	L980844-2	04/22/98	DH-10A
8	ASEH-9804-102	L980844-3	04/22/98	DH-24
5	ASEH-9804-103	L980844-4	04/22/98	DH-16
2	ASEH-9804-104	L980844-5	04/22/98	DH-9
2	ASEH-9804-105	L980844-6	04/22/98	DH-9
7	ASEH-9804-106	L980844-7	04/22/98	DH-23
6	ASEH-9804-107	L980844-8	04/22/98	DH-21S
6	ASEH-9804-108	L980844-9	04/22/98	DH-21D
4	ASEH-9804-109	L980844-10	04/22/98	DH-12
1	ASEH-9805-100	L980941-1	05/06/98	DH-6
3	ASEH-9805-101	L980941-2	05/07/98	DH-10A
2	ASEH-9805-102	L980941-3	05/07/98	DH-9
7	ASEH-9805-103	L980941-4	05/07/98	DH-23
4	ASEH-9805-104	L980941-5	05/07/98	DH-12
8	ASEH-9805-105	L980989-1	05/11/98	DH-24
8	ASEH-9805-106	L980989-2	05/11/98	DH-24
5	ASEH-9805-107	L980989-3	05/11/98	DH-16
9	ASEH-9805-108	L980989-4	05/11/98	DH-28S
9	ASEH-9805-109	L980989-5	05/11/98	DH-28D
6	ASEH-9805-110	L980989-6	05/12/98	DH-21D
6	ASEH-9805-111	L980989-7	05/12/98	DH-21S
10	ASEH-9806-100	L981158-1	06/03/98	PLANT

LAB NUMBER ORDER

Page	Lab ##	Sample Number	Date	Site Code
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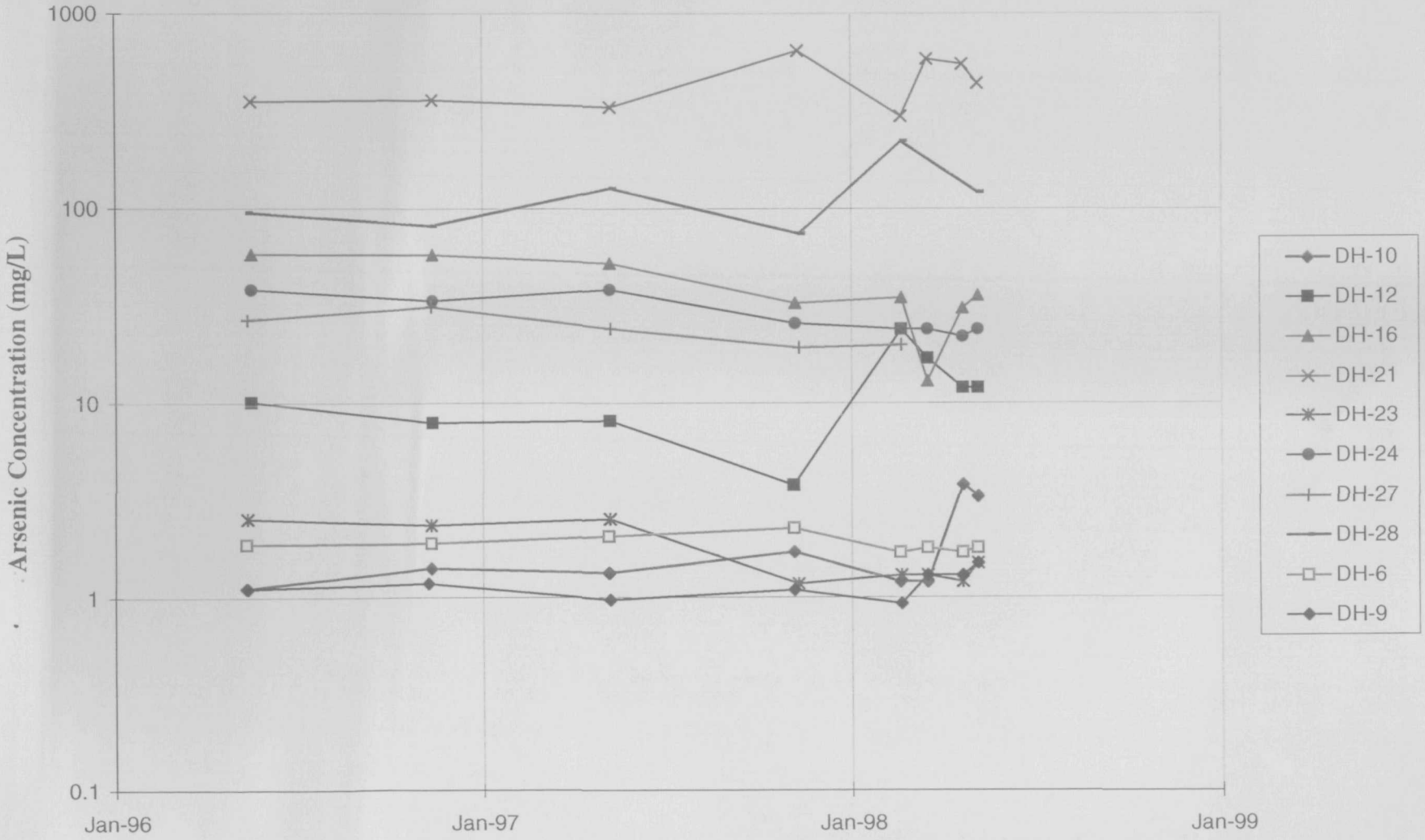
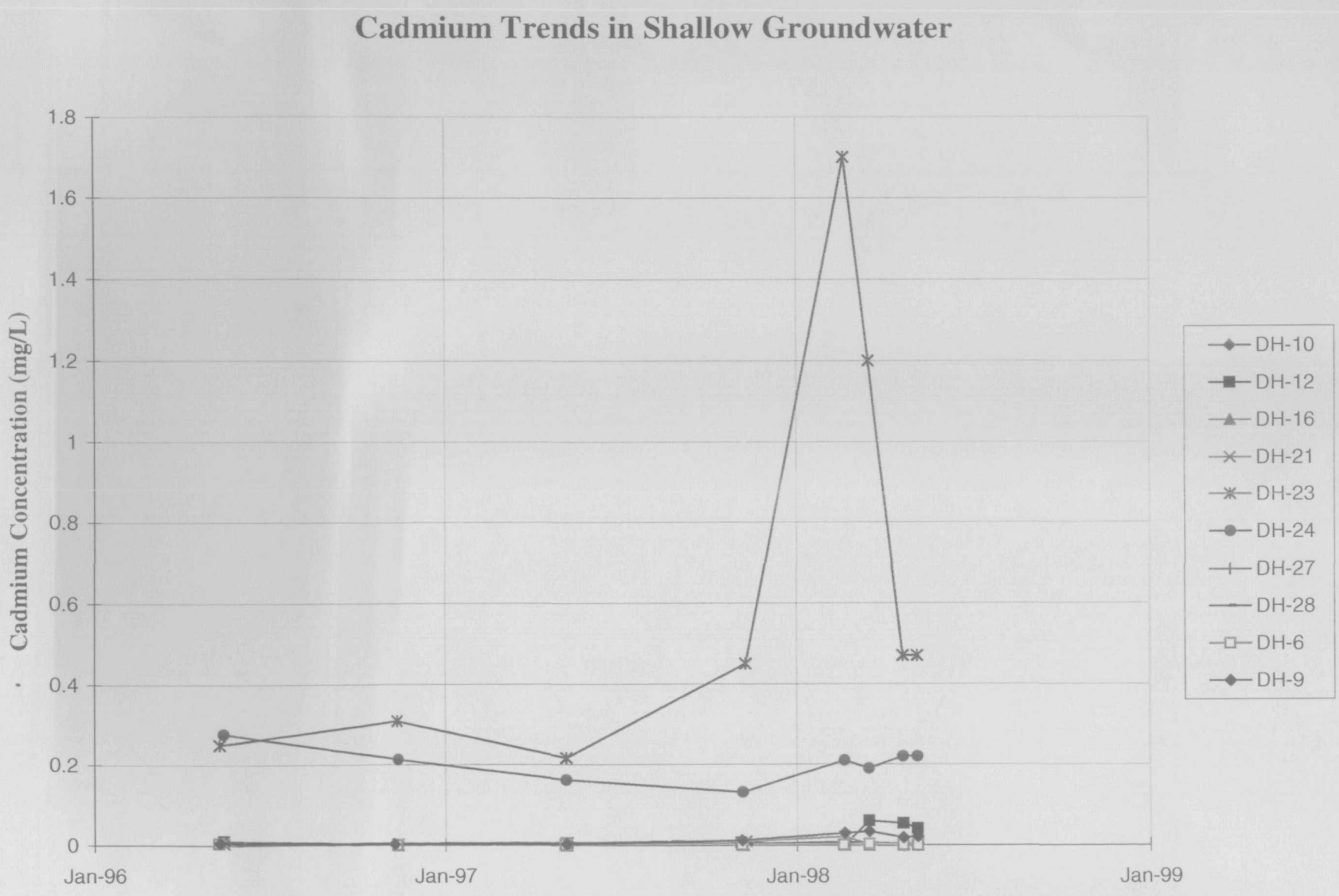
5	L980404-10	ASEH 9802-109	02/20/98	DH-21
9	L980404-11	ASEH 9802-110	02/20/98	DH-28
9	L980404-12	ASEH 9802-111	02/20/98	DH-28
8	L980404-13	ASEH 9802-112	02/20/98	DH-27
10	L980404-14	ASEH 9802-113	02/20/98	PLANT
11	L980404-2	ASEH 9802-101	02/19/98	PPC-5
3	L980404-3	ASEH 9802-102	02/19/98	DH-10A
1	L980404-4	ASEH 9802-103	02/19/98	DH-6
7	L980404-5	ASEH 9802-104	02/20/98	DH-23
1	L980404-6	ASEH 9802-105	02/20/98	DH-9
4	L980404-7	ASEH 9802-106	02/20/98	DH-16
7	L980404-8	ASEH 9802-107	02/20/98	DH-24
3	L980404-9	ASEH 9802-108	02/20/98	DH-12
3	L980601-1	ASEH-9803-100	03/18/98	DH-10A
1	L980601-2	ASEH-9803-101	03/18/98	DH-6
2	L980601-3	ASEH-9803-102	03/18/98	DH-9
2	L980601-4	ASEH-9803-103	03/18/98	DH-9
7	L980601-5	ASEH-9803-104	03/18/98	DH-23
8	L980601-6	ASEH-9803-105	03/18/98	DH-24
4	L980601-7	ASEH-9803-106	03/18/98	DH-16
4	L980601-8	ASEH-9803-107	03/18/98	DH-12
5	L980601-9	ASEH-9803-108	03/18/98	DH-21
1	L980844-1	ASEH-9804-100	04/22/98	DH-6
4	L980844-10	ASEH-9804-109	04/22/98	DH-12
3	L980844-2	ASEH-9804-101	04/22/98	DH-10A
8	L980844-3	ASEH-9804-102	04/22/98	DH-24
5	L980844-4	ASEH-9804-103	04/22/98	DH-16
2	L980844-5	ASEH-9804-104	04/22/98	DH-9
2	L980844-6	ASEH-9804-105	04/22/98	DH-9
7	L980844-7	ASEH-9804-106	04/22/98	DH-23
6	L980844-8	ASEH-9804-107	04/22/98	DH-21S
6	L980844-9	ASEH-9804-108	04/22/98	DH-21D
1	L980941-1	ASEH-9805-100	05/06/98	DH-6
3	L980941-2	ASEH-9805-101	05/07/98	DH-10A
2	L980941-3	ASEH-9805-102	05/07/98	DH-9
7	L980941-4	ASEH-9805-103	05/07/98	DH-23
4	L980941-5	ASEH-9805-104	05/07/98	DH-12
8	L980989-1	ASEH-9805-105	05/11/98	DH-24
8	L980989-2	ASEH-9805-106	05/11/98	DH-24
5	L980989-3	ASEH-9805-107	05/11/98	DH-16
9	L980989-4	ASEH-9805-108	05/11/98	DH-28S
9	L980989-5	ASEH-9805-109	05/11/98	DH-28D
6	L980989-6	ASEH-9805-110	05/12/98	DH-21D
6	L980989-7	ASEH-9805-111	05/12/98	DH-21S
10	L981158-1	ASEH-9806-100	06/03/98	PLANT

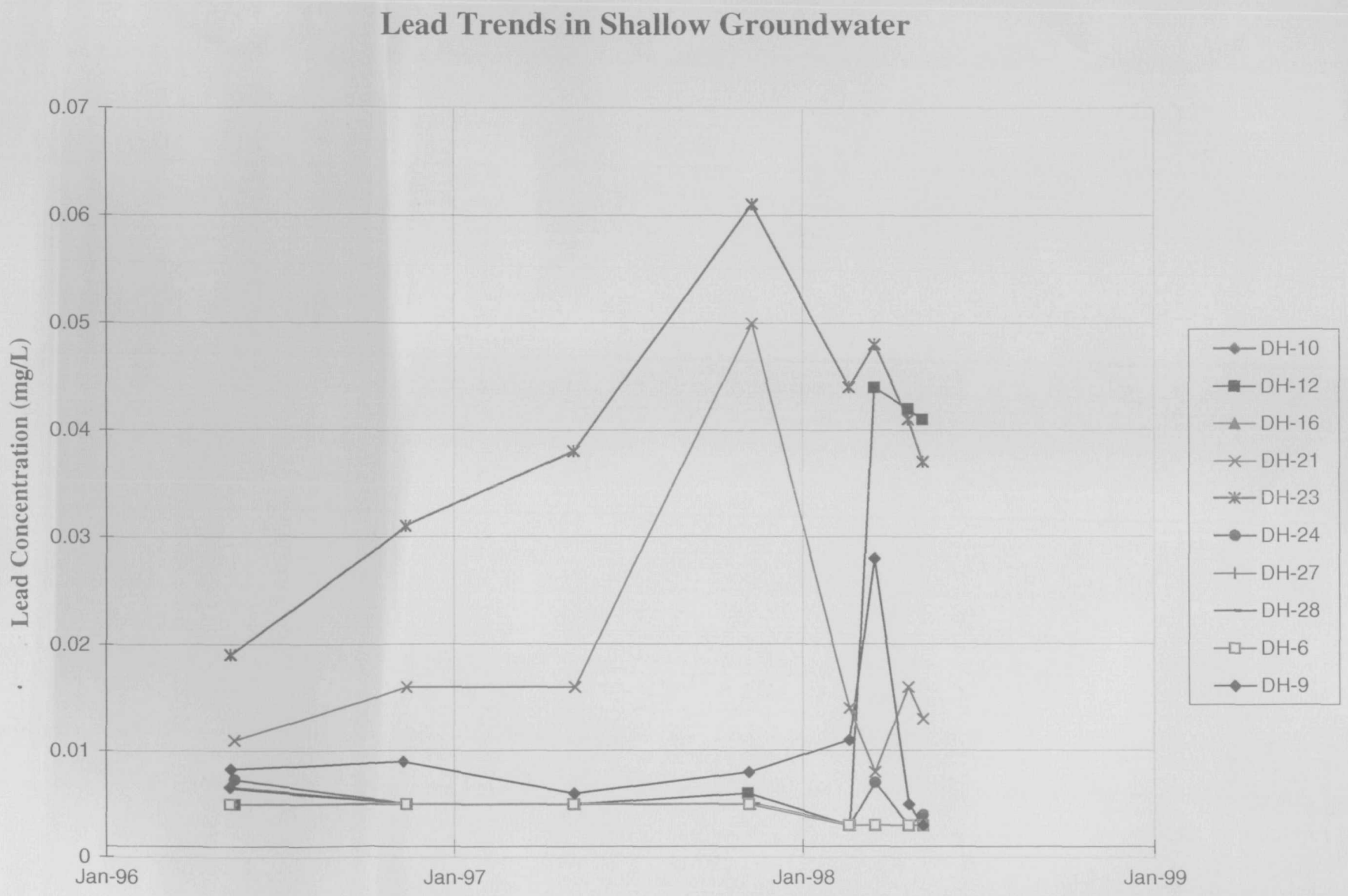
APPENDIX B

WATER QUALITY GRAPHS

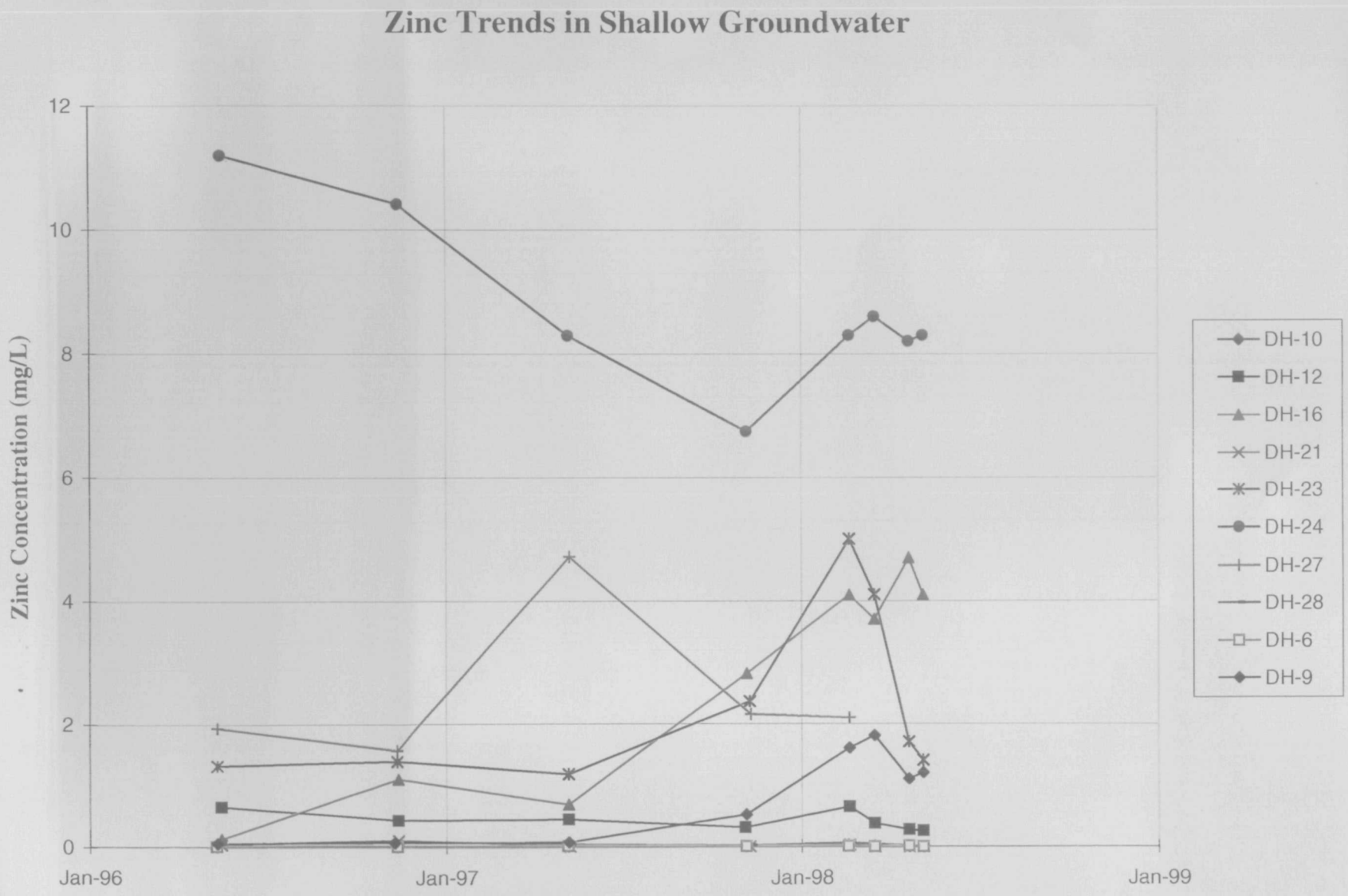
ArsenicTrends in Shallow Groundwater




Cadmium Trends in Shallow Groundwater
Cadmium Concentration (mg/L)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jan-96
Jan-97
Jan-98
Jan-99
DH-10
DH-12
DH-16
DH-21
DH-23
DH-24
DH-27
DH-28
DH-6
DH-9


Lead Trends in Shallow Groundwater
Lead Concentration (mg/L)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Jan-96
Jan-97
Jan-98
Jan-99
DH-10
DH-12
DH-16
DH-21
DH-23
DH-24
DH-27
DH-28
DH-6
DH-9

Zn-Chart1


Zinc Trends in Shallow Groundwater
Zinc Concentration (mg/L)
12
10
8
6
4
2
0
Jan-96
Jan-97
Jan-98
Jan-99
DH-10
DH-12
DH-16
DH-21
DH-23
DH-24
DH-27
DH-28
DH-6
DH-9

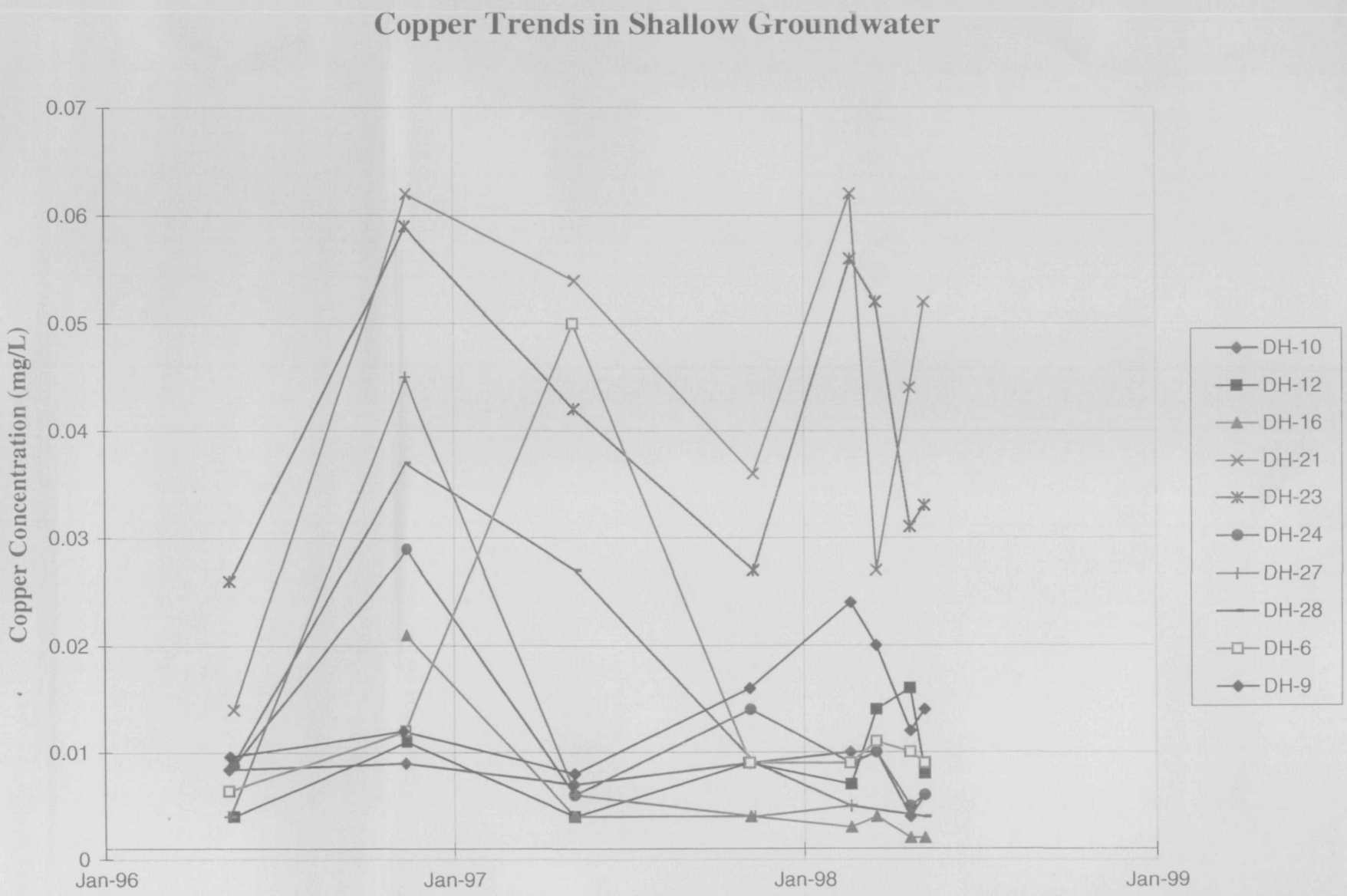

Copper Trends in Shallow Groundwater
Copper Concentration (mg/L)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Jan-96
Jan-97
Jan-98
Jan-99
DH-10
DH-12
DH-16
DH-21
DH-23
DH-24
DH-27
DH-28
DH-6
DH-9

EXHIBIT 1

MONITORING WELL LOCATIONS

ASARCO EAST HELENA

(K:\DATA\PROJECT\0867\SPILFIG1.SRF)

TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 1060838

SITE NAME: EAST HELENA NPL (OU2-RV1 RESIDENTIAL), EAST HELENA RCRA CORRECTIVE ACTION

DOCUMENT DATE: 07/30/1998

DOCUMENT NOT SCANNED

Due to one of the following reasons:

- ☐ PHOTOGRAPHS
- ☐ 3-DIMENSIONAL
- ☑ OVERSIZED
- ☐ AUDIO/VISUAL
- ☐ PERMANENTLY BOUND DOCUMENTS
- ☐ POOR LEGIBILITY
- ☐ OTHER
- ☐ NOT AVAILABLE
- ☐ TYPES OF DOCUMENTS NOT TO BE SCANNED
  (Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

EXHIBIT 1 MONITORING LOCATIONS

Contact the Superfund Records Center to view available document.
(303) 312-6473

OFFICE LOCATIONS FOR HYDROMETRICS, INC.

HELENA (Corporate)
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Helena, MT 59601
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FAX: (406) 443-1252

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Tacoma, WA 98402
Phone: (253) 572-5481
FAX: (253) 572-5487

SPOKANE
201 W. North River Drive
Suite 440
Spokane, WA 99201
Phone: (509) 328-3589
FAX: (509) 328-3827

TUCSON
3275 W. Ina Road, Suite 205
Tucson, AZ 85741
Phone: (520) 544-3150
FAX: (520) 544-3190

EAST HELENA
2 South Morton Street
East Helena, MT 59635
Phone: (406) 227-3341
FAX: (406) 227-3364

BILLINGS
5825 Lazy Lane
Billings, MT 59106
Phone: (406) 656-1172
FAX: (406) 656-8912

DENVER
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P.O. Box 16047
Denver, CO 80216
Phone: (303) 297-3109
FAX: (303) 297-3818

EL PASO
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El Paso, TX 79911
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KALISPELL
22 - 2nd Avenue
Suite 1100
Kalispell, MT 59901
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Kellogg, ID 83837
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